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ABSTRACT

This compilation consists of 26 consecutive issues of the journal "Seedbed," published from February 1979 through July 1986. Each issue contains articles written by teachers for teachers. "Seedbed" is an outcome of the Teachers' Center Project at Southern Illinois University at Edwardsville. It is designed to be neither scholarly nor trivial. Each issue is a collection of teachers' ideas thought to be worth sharing with other teachers as "seedlings," helping teachers to construct a point of view toward the intellectual growth of children or promoting children's thoughtful probing of mathematical ideas. (MNS)

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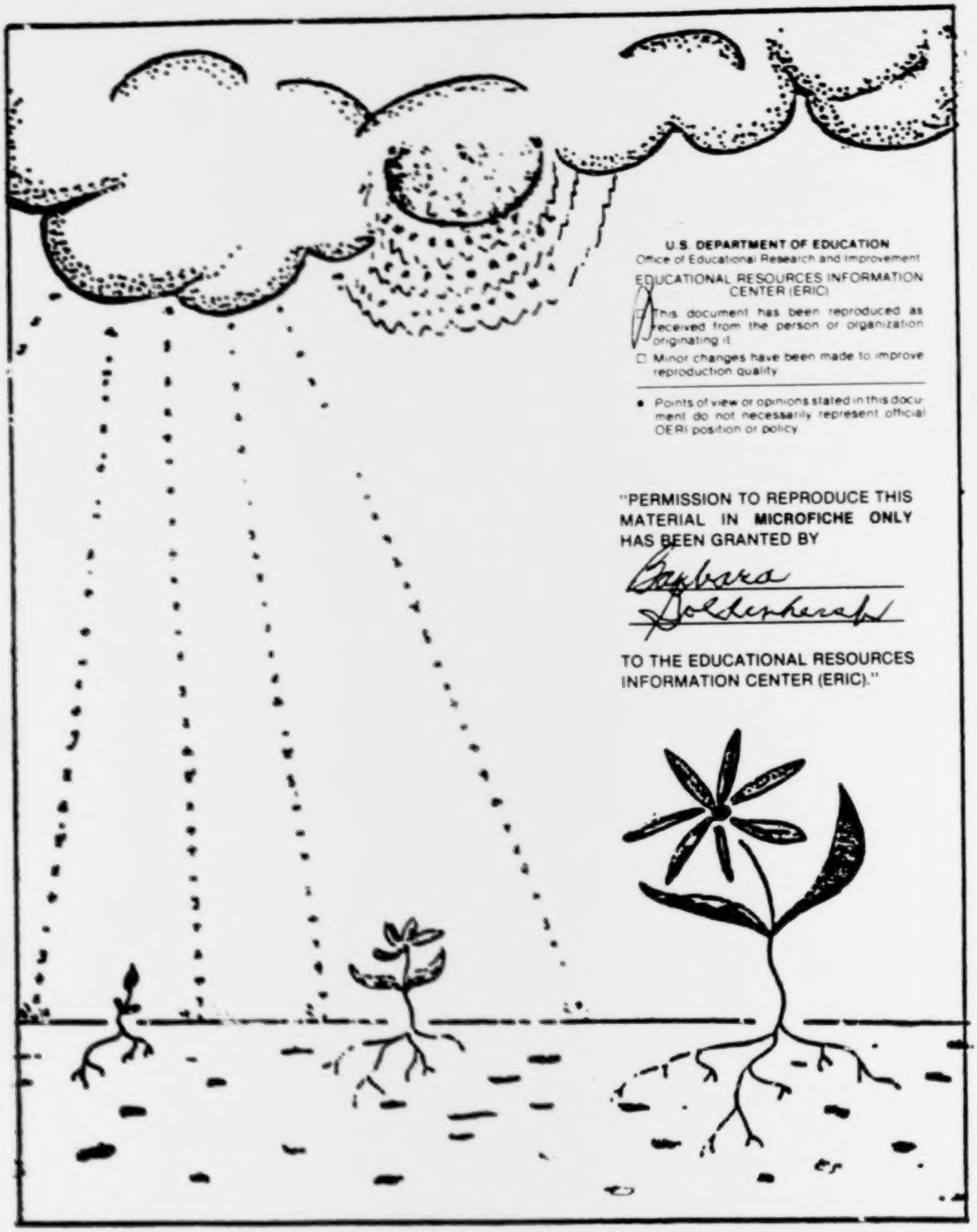

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SEEDBED

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Seedbed

Volume 1
Number 1

February 1979

Teachers' Center Project

Southern Illinois University at Edwardsville

ABOUT SEEDBED

This is not an ordinary journal. It's a journal by teachers for teachers. It's not crammed with experimental designs and statistical techniques as are most "scholarly" publications in education. Nor is it a collection of recipes for teachers to follow as are many textbooks and many "popular" educational publications. Rather, it is a collection of teachers' ideas, ideas they thought worth sharing with other teachers as seedlings to be developed.

Our interest is in helping teachers to construct a point of view toward the intellectual growth of children so that they can become self-sustaining both intellectually and professionally, and so that they are not at the mercy of the whims and fads and bandwagons. Our point of view is that education is concerned with people and ideas and their growth and intermixing, not with the production of "widgets", all the same and all inert. Our point of view is that knowledge is a personal construction and that the most important knowledge is that which both sticks and generalizes.

SEEDBED differs from most educational publications in several respects:

-- The Journal will not appear on a fixed schedule. We'll "publish" whenever we have enough ideas worth sharing. As things look now -- our three Teachers' Centers are humming -- SEEDBED may appear quarterly.

-- The Journal will welcome articles which relate to -- extend, elaborate, contradict, explain -- the issues undertaken herein and the issues undertaken at past (There are a great many seedlings now planted.) and at ongoing Teachers' Center sessions. Those in touch with our affairs are encouraged to share their ideas by sending them double-spaced, typed copy to the Teachers' Center Project.

-- The articles submitted to the Journal need not be fully developed and neatly packaged, nor is standard journal format required. Rather, we are planning that SEEDBED articles will 1) deal with issues of importance to the intellectual growth of children and teachers' participation therein and 2) amount largely to a simple sharing of ideas by teachers with teachers. Two important characteristics for articles are that they should act as intellectual seedlings, to be grown and nutured and extended by the reader, and that the writer should feel a strong sense of, "Oh boy, this is a good idea. It's too good to keep to myself."

As will be immediately clear from the articles herein, teachers are capable of immensely rich thinking. This is a notion not widely appreciated, not the least by American teachers themselves. And, as is also clear from this Journal and from the seven years of work of the Teachers' Center Project, teachers as a professional group are quite capable of bringing health to this often sickly organism called American education.

To produce SEEDBED has been a great joy. I am grateful to Shirley Casey for her help in getting SEEDBED going, to the staff of the Teachers' Center Project for their technical assistance, and to the contributors herein for sharing their seedlings.

University City, Missouri
February 1979

Thomas C. O'Brien

THE SEEDS

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Right Angle Paths

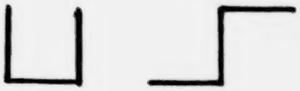
Chiquita Harrison

Rules

1. Place the toothpicks end to end.
2. Always make a right angle.
3. No squares are allowed.
4. Different positions of the same figure do not count.

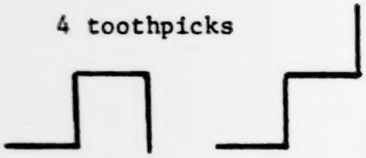
Examples

3 toothpicks



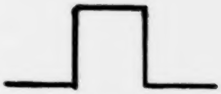
only 2 figures

4 toothpicks



only 2 figures

5 toothpicks



4 figures

Find the other 3.

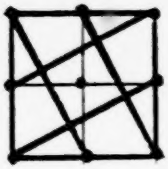
How many different paths can you make with 6 toothpicks?

This article springs from work done at the East St. Louis Teachers' Center during the fall quarter, 1978.

An Attack on the Area of a Square

Shirley Casey Betty Clemens

As we were attempting to determine how many squares could be formed on a 10 by 10 geoboard we had been noting areas of squares identified. Doing so hadn't presented any great problem because the areas were readily apparent. At the completion stage of the examination of one mode of squares, David placed 2 rubber bands on our geoboard in the following configuration:

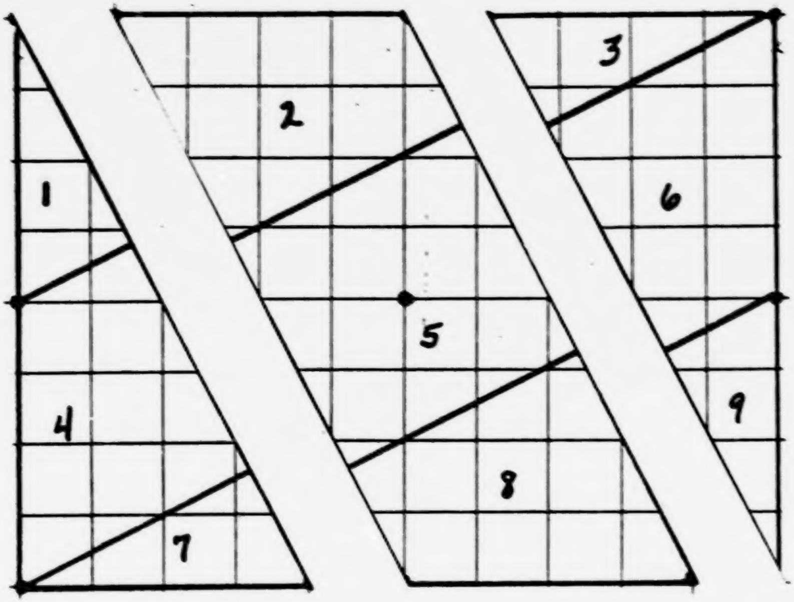


This presented a totally new problem. Because the square formed has no nails at the corners, we had lost our frame of reference for determining area. As we attempted to determine the area of this square, we estimated the area would be ½ of the area of a square formed by the nails used. But how to prove this became the problem.

We worked visually at first. When the width of the rubber bands caused distortion, we drew the figures on squared paper.

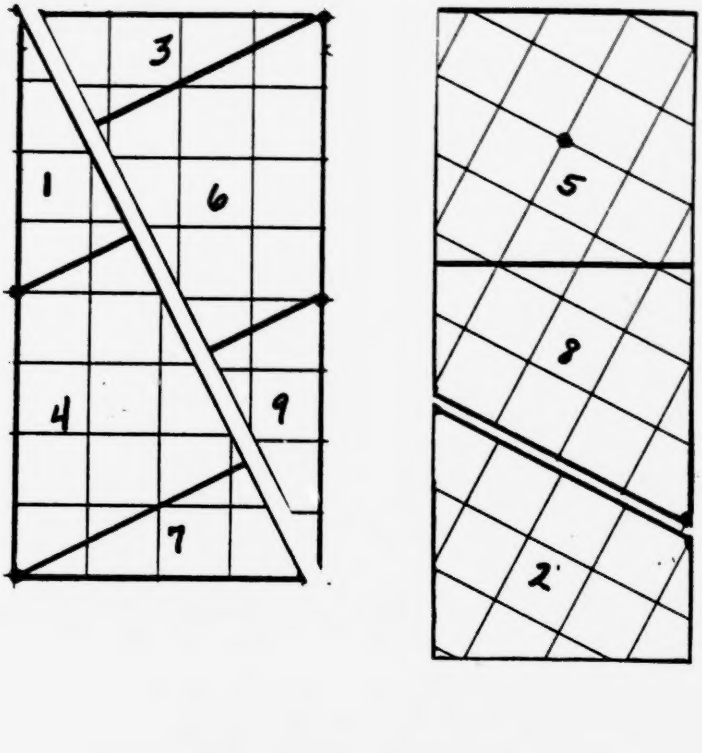
We tried tracing the construction and hoped that flipping the tracing and using it as an overlap on the original drawing would give a clue. It didn't. But it did give us the idea to enlarge the construction.

We enlarged it to 4 times the original size. That didn't seem to help immediately. So we decided to do some cutting.



Nothing was obvious to us at this point and so we cut some more.

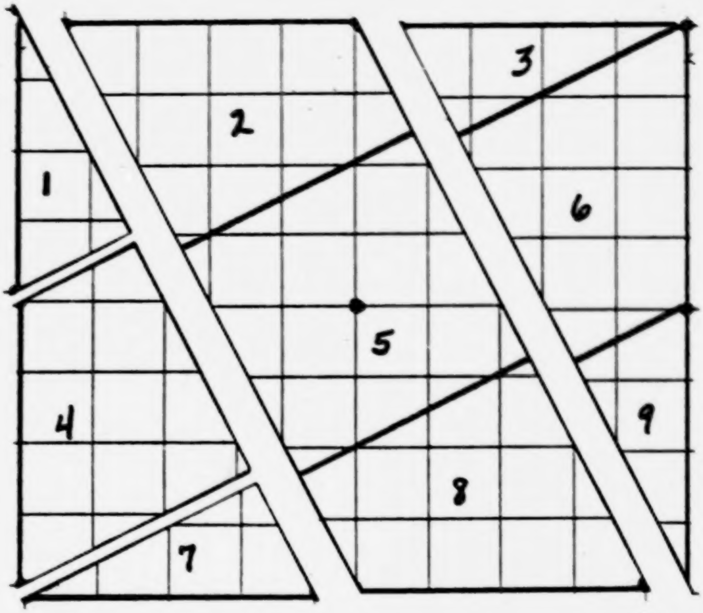
We knew that central parallelogram was equal to the sum of the remaining pieces because each of the cuts bisected half of the original square.



Since the central parallelogram rearranged still equals half the original square, it is obvious that #5 is not ¼ the original square. Our hypothesis went down the drain. Now what? If it isn't ¼, what is it?

This left us at loose ends -- we tried more enlargements, several overlays and rearrangements. Nothing was apparent.

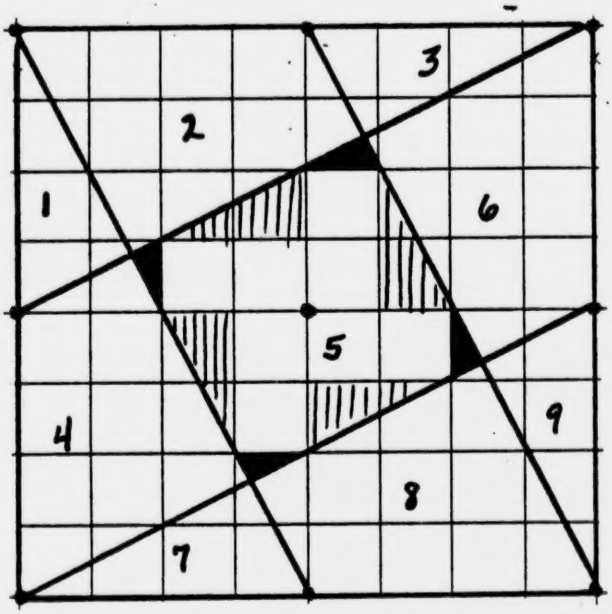
Tom then cut one of the triangles into pieces giving us the following, which we played with for several minutes.



Now came the supper break and as we carried all our bits of cut paper into the elevator, piece number 7 fell down into the elevator shaft.

After dinner we didn't reconstruct the lost pieces, because we felt this was another blind alley. We tried other routes.

We decided to try to determine the area of Section #5 by breaking it up.



We counted the whole squares (unshaded, within Section #5) and determined that there were 8 of them. Then the large remaining triangles (striped) each had an area of 1 because each was constructed by a diagonal that bisected 2 squares. That left only the tiny triangles (black). Since they were right triangles, we attempted to use trigonometric functions to help us.

Since the hypotenuse of the little triangle was known to be 1, knowing the sine of each angle would give us the lengths of the other 2 sides. We reasoned that one of the acute angles was twice the size of the other since the sides opposite them has that relationship.

David questioned us about this and since we weren't sure of the validity of our assumptions, we abandoned it for other methods.

We knew that the tangent of the smaller acute angle was ½ but we didn't have access to tables that would give us the angle size. Another blind alley.

Alex joined in at this point (he'd been working alone). By theorems we remembered from high school geometry we knew that the tiny triangles were similar to the large triangles whose hypotenuses carried the sides of the square in question. (That is, the bottom black triangle is similar to the triangle consisting of Sections #7-8-9, etc.).

We then reasoned that the lengths of sides of similar triangles are proportional.

So, $\frac{\text{length of small}}{\text{length of large}}$ as $\frac{\text{height of small}}{\text{height of large}}$ as $\frac{\text{hypotenuse of small}}{\text{hypotenuse of large}}$

Now $x : 8$ as $y : 4$ as $1 : \sqrt{8^2 + 4^2}$

$$x : 8 = 1 : \sqrt{64 + 16}$$

$$\frac{x}{8} = \frac{1}{\sqrt{64 + 16}}$$

$$8 = \sqrt{64 + 16}\ (x)$$

$$\frac{8}{\sqrt{64 + 16}} = x$$

$$\frac{8}{\sqrt{80}} = x$$

$$\frac{y}{4} = \frac{1}{\sqrt{64 + 16}}$$

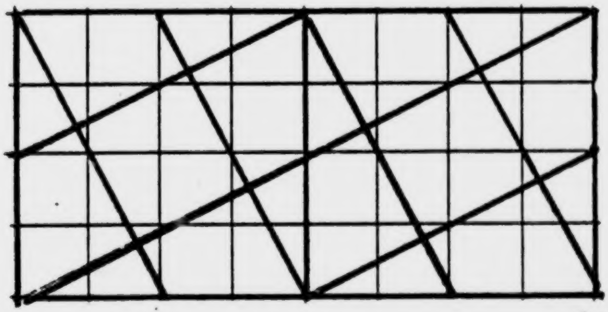
$$4 = \sqrt{80}\, y$$

$$\frac{4}{\sqrt{80}} = y$$

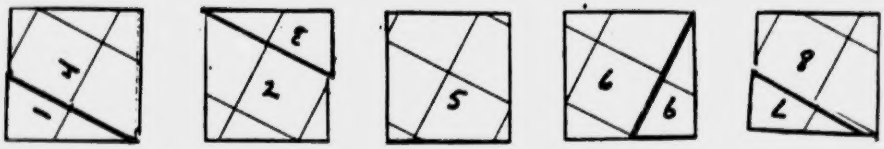
Since we now knew the side lengths of the tiny triangle it was not difficult to calculate the area of the central square to be 12 4/5 sq. units, which is 1/5 of the total area.

At this point Kathy told us how she had reached the same conclusion. Each of us proceeded to illustrate what she'd said. Look at the difference.

Betty did:



Shirley did:



SHEESH!

This process spanned nearly 48 hours. If we had not lost piece 7 in the elevator shaft, we wouldn't have learned nearly as much about how we learn.

Looking back at the total processes, we realized that bits of mathematical information learned long ago got in our way because since we'd never really made them our own, they weren't ours to use. They also blocked us from considering the the problem in its simplest form. We seemed to be hung up on the idea of finding the right formula instead of deriving it.

One of the things that kept us moving on this problem was having other people around who caused us to consider alternative pathways.

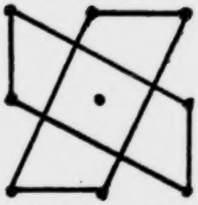
Our last question of ourselves as we reflected on our work was, "Why would two intelligent, reasonably sane, time-pressured adults with many responsibilities spend nearly two days laboring in an attempt to produce the area of one small square?" The problem grabbed us, it gave us a chance to do problem solving, and provided us with an arena to examine our own learning processes. We were free to pursue, belabor or drop the problem as we saw fit and it felt SOOOOOOO good when we finally solved it!

This article appeared in the December 1978 issue (Number 85) of Mathematics Teaching, the journal of the Association of Teachers of Mathematics (United Kingdom). The article springs from work done at the Teachers' Center Project's summer course, 1978.

My Math Education is Gone

Kathleen Metz

David hands me a geoboard with a square formed that touches no nails.

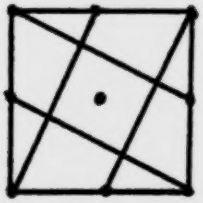


"What's the area" he asks. (This entry is an account of my struggle with the problem. If you'd like to try the problem yourself, do so before reading further.) I stare at the board, wondering what kind of formulas would help me solve the problem.

I start by adding rubber bands to form shapes bounding or dividing the initial troublesome form. I need to begin the way my 8 or 9 year old students approached area problems. As I add the rubber bands I become aware of my criteria for helpful rubber band placements:

Rule 1. The original figure is divided into triangles or rectangles, shapes for which I can calculate area.
Rule 2. There is a nail at each corner of the shape.

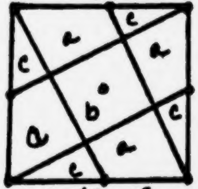
I can only find one placement that meets my criteria: a band stretching around nails outside my square.



Again I stare at the figure, sensing there is mathematics I've been taught that would help. I vaguely remember doing "geometric proofs". Would they help? What were they? Do sines, cosines and tangents have anything to do with this? Once I could "do" those problems easily. I've forgotten how to go about geometric proofs. I can't even remember the symbol system. Sines, cosines and tangents? I never did understand where the tables came from.

I wonder what I have now from my four years of high school math. Processes and formulas? I find they're largely gone... perhaps crumbled because I never constructed them myself. A sharpening of the mind? No, I can't believe that; math and boredom came together. Doing mathematics was following steps dictated by the teacher to magically produce right answers... answers I knew were right because the teacher said so. But this teacher gives me a problem without a process... I feel lost.

Maybe algebra would help. I start labeling my shapes, using an intuitive notion (once formal) of complementary and equivalent angles.



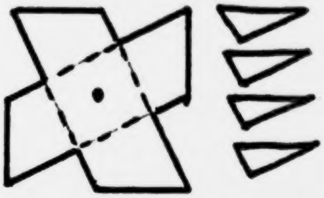
I define my big square as a unit of one. I write:

$$4a + 4c + b = 1$$
$$a + c = b$$
$$a + 4(b-a) + b = 1$$

I stare at the letters. The letters are bringing on a sense of panic and incompetence. I am losing their relationship with the board. The connection broken, I don't know what question to ask next.

David sees my panic. I want his help but I don't want his help. I am able to do this problem myself! David, please don't do this problem for me... But I'm getting nowhere now.

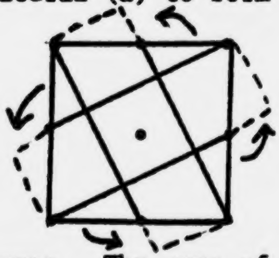
David hands me the shapes I have made on the geoboard in the form of paper cut outs. He leaves the troublesome square attached to the a's



He suggests that I forget about the letters.

I play with the shapes. I see relationships... The relationships are the same as those I had discovered symbolically.

David takes away the shapes. What's the area of the square? I find myself flipping between the concrete problem and my symbolic system. Each gives the other greater clarity and order. I realize that as a + c = b, so I can place the triangle (c) on the end of the quadrilateral (a) to form a square the same size as my problem square.



I have five of these squares. The area of one of these squares is obviously 1/5 the area of the five. The area is 1/5. This I know.

This article appeared in the December 1978 issue (Number 85) of Mathematics Teaching, the journal of the Association of Teachers of Mathematics (United Kingdom). The article springs from work done at the Teachers' Center Project's summer course, 1978.

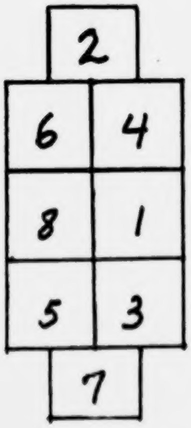
Number Puzzle

Elizabeth Thomas

Number of participants: 1 or 2

Materials needed: Numbered 1 x 1 inch ceramic tiles, plastic numbers with adhesive backs (1-8), or small square pieces of paper (1-8).

What do do: Children place numbers in arrangement below, so that no two consecutive numbers touch each other horizontally, vertically or diagonally. One possible solution is listed below. Can you arrange another? How many can you find?



This article springs from work done at the East St. Louis Teachers' Center during the fall quarter, 1978.

EXCERPTS

Joan Tamburrini

In math education it seems to me that what we have sometimes done is to exchange for the old traditional rote computation stuff in math, work with concrete materials and work with apparatus. What we were attempting was to give the children a collection of images in the hope that they would add up to the concept. Now Piaget's answer is that they do _not_ learn concepts through the amassing of images. His answer as to how conceptual development takes place is that they learn through action. In a book called _Main Trends in Psychology_ he writes, "For a long time it was thought that children learned only what was inscribed in advance in an already organized external world and especially what they were taught by adults. Yet the two main lessons we have learned from children are 1) that the universe is organized only inasmuch as its organization is reinvented step by step with objects, space, time, and causality being structuralized in accordance with logical form and

2) that nothing is ever learned from teachers unless their thought processes are also followed through, failing which nothing remains either in the mind or the memory. In short, child psychology teaches us that development is a real constructive process, that it is a _construction_ of structures and _not_ an additive accumulation of isolated acquisitions."

Well, so far as Piaget's work is concerned, I don't think I can do better than leave you with that quotation. But by way of summing up let me just say a few things about the implications, in part to repeat what I have already said but also to say a few things more. What are the implications then for teachers including, of course, the implications for in-service training in teachers' centers or anywhere else?

I think the first thing is a question of values. I've said that Piaget's evidence supports a position of the human individual as an active learner constructing reality. Now that doesn't mean that you _necessarily_ have to base what you do in education on that. You can choose to do that or you can choose to forget all about it and concentrate on children acquiring skills, on conditioning, on behavioral objectives or what have you. So what you first have to do is to make a decision about your values in education. There is no doubt a great deal of evidence to suggest that we _can_ condition children. There is also evidence to suggest that we _can_ produce more autonomous human beings. So we have to make a decision because we will produce children according to the way we arrange things. We can arrange things so that we condition children or we can arrange things so that we produce autonomous learners. So there's a value question and I think that in the in-service training of teachers we need to help them to scrutinize their values and to be aware of what the range is.

Second is another question of values. Teachers need to scrutinize values and make decisions about whether they are going to go for cooperative individuals or competitive individuals. You can, of course, get certain bits of learning going through competition. You can use that as an incentive. But you will bring about side effects and those side effects, I think, would militate against the sort of thing I've tried to tease out in my theoretical model. In other words, in constructing reality the learner has to try to see something from another person's point of view. I talked also about finding out where the learner is and organizing things so that the teacher pays attention to individual differences both of a quantitative and a qualitative sort. Now you are not likely to get this going if you've got a highly competitive situation which is necessarily comparative, where children are being compared in terms of the same yardstick. So here is another ethical principle that teachers need to look at.

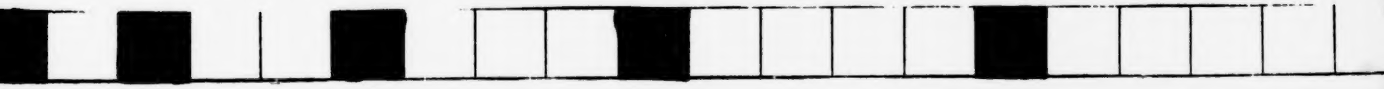
The third principle is that when a teacher has provided a classroom with a diversity of materials, each of which has within them a potential for diversification, children can operate at different conceptual levels and will operate at conceptual levels, but they will also operate in relation to different concerns and preoccupations. So what is needed is that a teacher then is able to relate to children diagnostically to find out what they are paying attention to. And by diagnosis, of course, I don't necessarily mean by giving tests. Somebody asked the question this morning about evaluation and the answer was (I think Ted Orsborn, wasn't it?) that the on-going recording by a teacher -- the recording of what a child is doing -- is part of the evaluation that is going on day by day.

The preceeding is an excerpt from "Implications of Piagetian Research for Education", a publication of the Teachers' Center Project.

Struggles with a Progression

Jack Story Jeanne Coyne Sister M. Rosetta, S.S.N.D. Bob Orrell

In attempting to determine the 100th cube in the given pattern



the following procedures were followed. On blocked paper the pattern was extended and a sequence was observed.

Order to Black Cubes	Number of White Cubes Following Black Cubes
1st	1
2nd	2
3rd	3
4th	4
5th	5

To see this in another way the following was set up

black = b numerals indicate the number of white cubes

$(b + 1) + (b + 2) + (b + 3) + (b + 4) + (b + 5) + (b + 6)$

Total cubes in set 2 3 4 5 6 7

$(b + 7) + (b + 8) + (b + 9) + (b + 10) + (b + 11) + (b + 12) + (b + 13)$

Total cubes in set 8 9 10 11 12 13

Seeking the color of the 100th cube the white colored cube was found in this way. The 12th black cube + 78 white cubes equaled 90 cubes. The 91st cube was black followed by 13 white cubes, therefore, the 100th cube had to be white.

Another chart followed:

Black Ordinal	Positional Ordinal
1	1
2	3
3	6
4	10
5	15
6	21
7	28

A relationship between these numerals was sought.

Black Ordinal	Position of Black Cubes
1 x 1	1
1½ x 2	3
2 x 3	6
2½ x 4	10
3 x 5	15
3½ x 6	21
4 x 7	28

If x = ordinal number of black cubes, then $\frac{x}{2} + \frac{1}{2}$ = the multiplier

$\frac{x}{2} + \frac{1}{2} x$ = final number of cubes to reach the xth black square, to be called y or $\frac{x^2 + x}{2} = x^2 + x = 2$ (final number).

From this point, trial and error estimation would soon show if a given square were black or white.

Thus, estimating x as 14, then:

$$\begin{aligned} x^2 + x &= 2y \\ 14^2 + 14 &= 2y \\ 196 + 14 &= 2y \\ 210 &= 2y \\ 105 &= y \end{aligned}$$

The 105th cube would be black.

x - 1 would be 13, so that:

$$x^2 + x = 2y$$
$$13^2 + 13 = 2y$$
$$169 + 13 = 2y$$
$$182 = 2y$$
$$91 = y$$

The 91st block would be black.

With both 91st and 105th being black, the 100th cube would be white.

Looking at "position of black cube" column, a relationship was observed.

3 and 6 were multiples of 3 (an odd number)

10 and 15 were multiples of 5 (the next odd number)

21 and 28 were multiples of 7 (the next odd number)

Further experimenting with the next odd number, 9, showed the following relationship:

1 x 1 = 1
1 x 3 = 3
2 x 3 = 6
2 x 5 = 10
3 x 5 = 15
3 x 7 = 21
4 x 7 = 28
4 x 9 = 36
5 x 9 = 45
5 x 11 = 55
6 x 11 = 66
6 x 13 = 78
7 x 13 = 91
7 x 15 = 105

The 100th cube has to be white, and thus, a fairly quick and simple method of finding if a given ordinal cube were white or black.

This article springs from work done at the Belleville Area Teachers' Center during the fall quarter, 1978.

Personalized Sentences

Elizabeth Thomas

Number of Participants: Individual, small group, or entire class

What to do: One the chalkboard, print the name of a famous person (names of teachers or students may also be used). Make up a sentence (or sentences) in which the words begin with those printed letters. Place the letters vertically on the board. The object of the activity is to get the most coherent possible sentence which fills the first letter condition and which is grammatically correct.

Example:

G reat
e lves
o r
r rabbits
g o
e verywhere.

W e
a ll
s aw
h ow
i t
n ever
g ets
t hrough
o ur
n eedles.

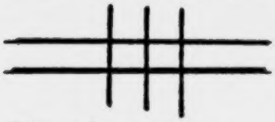
Print your name and get going.

This article springs from work done at the East St. Louis Teachers' Center during the fall quarter, 1978.

Crossroads

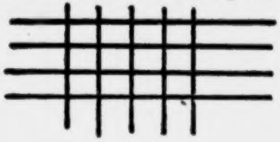
Thomas C. O'Brien

Suppose two roads go East-West and three go North-South.



How many crossings? Six of course.

What if four go East-West and five go North-South? How many crossings?

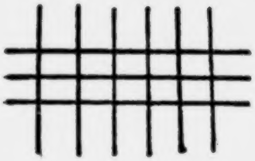


You're right, 20.

Try these. Pretend you don't know your multiplication tables. Just count crossings.

4 x 7 3 x 8 5 x 6

Suppose multiplication of whole numbers is given a new view. For any two numbers, a and b, a x b is the number of crossings got from a roads crossing b roads. All you need to do is to count. That is, 3 x 6 = 18 because three roads times 6 roads yields 18 crossings.

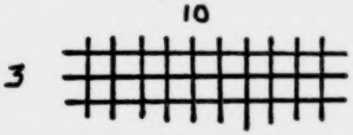


Use crossings diagrams (i.e. draw the roads) to complete the usual multiplication table. (Don't rely on table entries known from memory).

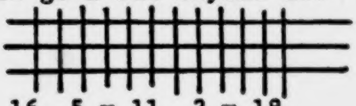
X	1	2	3	4	5	6	7	8	9
1									
2									
3									
4									
5									
6									
7									
8									
9									

What shortcuts did you find?

That done, try 3 x 10.

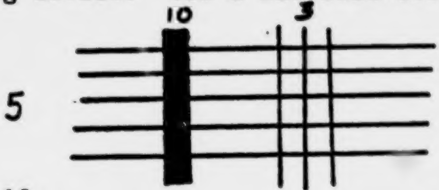


Try several of these. Now go a bit beyond 10. Try 3 x 12.

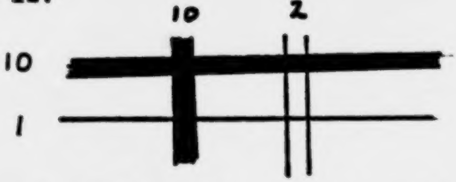


Try some others. Do 4 x 16, 5 x 11, 3 x 18.

A labor saving device. Use a fat road for 10 roads. Here's 5 x 13

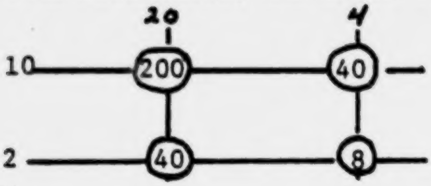


Now try 11 x 12.



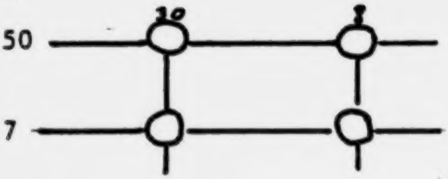
Fool around with this awhile. Try 24 x 13 and 31 x 25. Then try 42 x 17.

To save even more labor, the issue can be boiled down to this:



12 x 24 = 288

Try then:

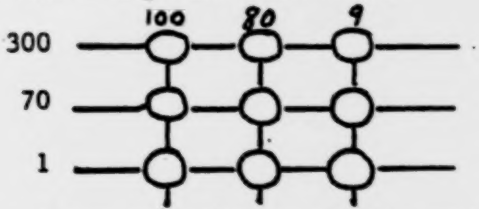


57 x 38 = ______

Try these using the labor saving crossing diagram.

34 x 17   19 x 84   81 x 24

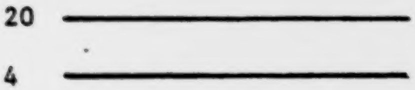
And now go for a big one: 371 x 189



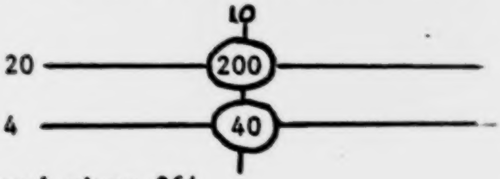
In general as you see, the crossroads method works. (Did you check it with a calculator or by using "real" multiplication?)

How about division? Forget all you know about division algorithms and use crossroads methods to solve this one:

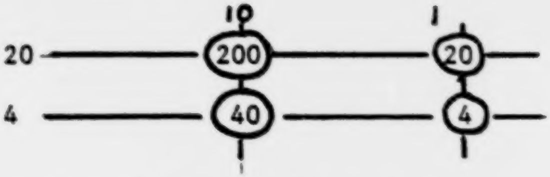
How many roads must cross 24 roads to get 264 crossings?



Let's see, if there were ten North-South roads, there'd be 240 crossings



One more road gives 264



That is 24 x 11 = 264 and so 264 ÷ 24 = 11

Try this with your children?

This article springs from work done at the Teachers' Center Project's summer course, 1978. This approach is becoming the standard approach to multiplication in Holland. See Thomas C. O'Brien, "Some Notes on Multiplication of Whole Numbers," Educational Studies in Mathematics, Utrecht, Fall 1970.

EXCERPTS

Herbert Ginsburg

Standard testing, I think, has rather limited value. Its value is greatly exaggerated. Standard testing from what I can see in mathematics and in other areas as well can only give you some rough notion of the standing of students relative to one another. This is, of course, of some usefulness. If you come across a third grade child doing arithmetic, you may want to know roughly whether this child is at the same level as third graders, fifth graders, college students, or four-year olds. That is a normative question; is this child doing relatively well compared to his peers. And standard testing handles that sort of thing reasonably well. It gives a rough indication: "All right, this child is roughly at a third grade level." This is really all that IQ tests do. It is all that achievement tests do. It is all that standard tests in general do. They tell you this child is at such and such a level relative to everybody else.

Aside from that the standard tests don't tell you much. They don't tell you how children go about doing anything. We can make some guesses.

If you have on an IQ test a bunch of vocabulary items and the child does well, you assume that his performance had something to do with his knowledge of language. But the test does not tell you in any detail what his knowledge of language is like. It is a very very rough indication. And usually my experience in the classroom is that the teacher sort of knows as much anyway from interacting with the child, so the tests don't tell the teacher very much more than what the teacher already knows. In some cases it may be valuable, but it general it is not.

The preceeding is an excerpt from "The Teacher as Researcher", a publication of the Teachers' Center Project.

What's My Rule

Mabel Davis

The Game: You start by asking a student to give you a number - any number is fine. However, it is suggested that you start with smaller numbers (0 to 10). If a student were to give you the number 4, you could say, "I will give you the number 10 back," and record it, as shown below, on the chalkboard.

4	10

You have performed some rule or operation on it. Then ask for another student to give you a number. You are given the number 7 and you say, "I will give you the number 13 back," and record it as

7	13

The game continues:

Student Gives	You Give
1	7
5	11
3	9
8	

After a few times ask, "Can you guess what I'm going to give you back?" (14) After it is obvious that several students have found the rule, you can vary the directions by saying, "If I give you the number 6 back, what number will you give me?" (0)

Then ask, "What's my rule?" In the case above it is "Add 6". This game can be used with any operation and with any set of numbers. You can vary it in complexity from a single operation to a multiple operation, such as multiply by 2 and add 3. Therefore, if a student gives you the number 6, you would give the number 15 back, and so forth.

This article springs from work done at the East St. Louis Teachers' Center during the fall quarter, 1978.

EXCERPTS

E.A. Orsborn

When operating the integrated day, one of the things we must realize is that this is not the hit-or-miss affair that frequently it becomes by people who are not paying attention to particular priorities. I think this is the first challenge to ourselves as professionals: that we as professionals must be totally conscious all the time of those clues that indicate the child is ready to develop a basic skill, and that you cannot offer these basic skills at a time before the child is ready. In other words, what I am saying is that understanding through conceptual experience must precede practice. In a nutshell, we don't teach children tables until they understand something of the mathematical implications behind them -- by ordering things, by developing ideas of one-to-one correspondence, by the kind of patterns that can be discovered in tables and by children handling concrete materials.

The preceeding is an excerpt from "On Literacy", a publications of the Teachers' Center Project.

Word Hunt

Elizabeth Thomas

Number of Participants: 1-25, as individuals or in small groups

Materials needed: Writing paper and pencil for each participant

What to do: Students list as many words as possible that can be made by removing the first letter of a word.

Example: open - pen; stop - top; learn - earn

Students may move about the room and use any source available for discovering words. A standard dictionary is the "umpire" in case of disputes.

This article springs from work done at the East St. Louis Teachers' Center during the fall quarter, 1978.

The Story of a Problem

David Fielker

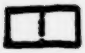
"Make a shape from a given number of squares, so that each square has at least one point in common with another square. What can you say about the perimeter ...?"

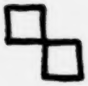
I think that was the problem that Jim MacLean posed, and there were some subsidary questions, which I tried to ignore because they seemed to close things up a little! This introduction is written a few days later, but what follows is a blow-by-blow account of how I tackled the problem.

Most mathematics we read or hear about is presented in a formal, polished way, with everything arranged logically. The mathematician, before presentation, removes all the illogicalities, the inconsistencies, the errors and the agonies. This account keeps them all in.

$1 \rightarrow \{4\}$

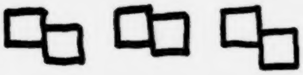
(Is it right to start off with the simple cases? Would I be more interested if I started with, say, five squares? Well, perhaps I can get these fairly quickly. I don't know yet how complicated this problem is going to be, even though I half-remember working on something similar some time ago.)





$2 \rightarrow \{6,8\}$

- but it depends on the rules. Jim said "at least one point in common":



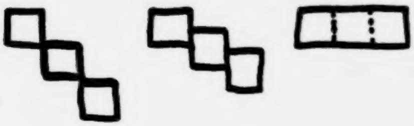
... this way I can get any perimeter between 6 and 8.

New notation needed: $2 \rightarrow (6,8)$

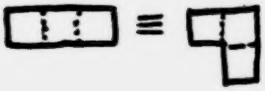
Meaning: 2 squares can give any perimeter from 6 to 8.

Hypothesis #1 given any number of squares I can achieve every perimeter between the minimum and the maximum.

If this is true, then a corollary is an answer to Jim's question about whether on can obtain all the integral perimeters.



3 ⟶ (8,12)

N.B.  (where ≡ means "has the same perimeter as")

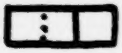
Theorem #1 maximum perimeter with n squares is 4n.

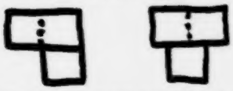
Proof obvious (as the professor always says).

Theorem #2 minimum perimeter with 3 squares is 8.

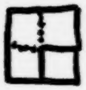
Proof I can "use up" 2 units of perimeter by putting 2 squares together edge to edge.

Having used up the first 2 squares this way I can only use up another 2 units of perimeter wherever I put the third square.





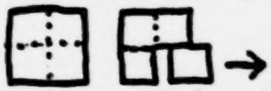
This is not going to be easy to generalise. 4 squares is already different.



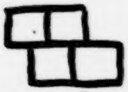
The fourth square can touch 2 others, and uses up a further 4 units, not 2.

4 ⟶ (8,16)

Further complications about hypothesis #1, which depended on 'sliding' squares along. If I slide one square along here



I create a discontinuity, and the perimeter jumps from 8 to just under 10. Can I get a perimeter of 9?

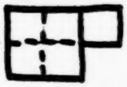
 !! (Panic over!)

Further support for hypothesis #1.

In view of hypothesis #1 and theorem #1, all I have to do is find the minimum perimeter for each number of squares.

1→ 4
2→ 6
3→ 8
4→ 8
(Hm.)

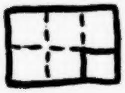
5→ ?



Every time I add a square I add 2 to the perimeter, unless I can join the square to 2 other squares.

5→ 10

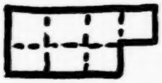
6→ 10.

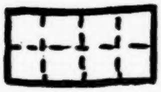


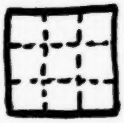
Hypothesis #2 For $n > 2$ and even, $p(n) = p(n-1)$.

(Where n is the number of squares and p(n) in the minimum perimeter.)

But I know already that this is not true, because although $p(7) = 12$ and $p(8) = 12$, $p(9) = 12$ as well.

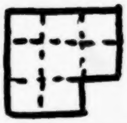






This is because I can arrange 9 squares were more 'compactly' than 8 squares.

Unless I arrange 8 squares thus:



(Another problem: how can I define and measure 'compactness'?)

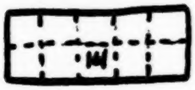
Obviously this has something to do with $9 = 3x3$.

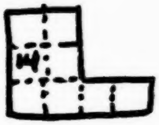
Hypothesis #3 If n is not prime, $p(n) = p(n-1)$.

So far:
$p(1) = 4$
$p(2) = 6$
$p(3) = 8$
$p(4) = 8$
$p(5) = 10$
$p(6) = 10$
$p(7) = 12$
$p(8) = 12$
$p(9) = 12$.

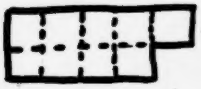
Hypothesis #4 If n is prime, $p(n) = p(n-1) + 2$.

$p(10) = ?$





Hypothesis #3 disproved! It depended on 9 square being arranged like this



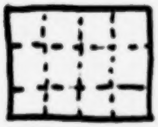
so that the 10th square could be joined to 2 others.

Replace it by:

Hypothesis #5 If n is not prime and n-1 is prime, then p(n) = p(n-1).

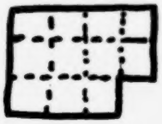
p(10) = 14
p(11) = 16
p(12) = (support for hypothesis #4)

Good Heavens! p(12) = 14



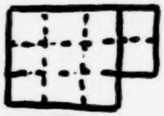
i.e. p(12) $<$ p(11).

Am I sure about p(11)? No!

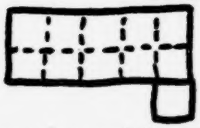


p(11) = 14, not 16.

That's because I can derive p(11) from p(9)



and not from p(10)



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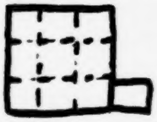
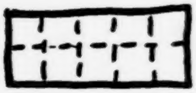
And, strangely, p(10) can be achieved either by attaching 1 square to 9



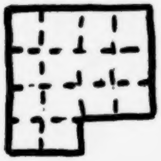
or by seeing 10 squares as 2 x 5 squares.



I wonder if this happens with other non-primes?

p(10) = 14
p(11) = 14 (disproof of hypothesis #4)
p(12) = 14 (support of hypothesis #5)
p(13) = 16
p(14) = 16 by hypothesis #5.

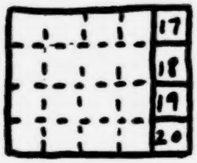
Check:



- and we seem to be working towards a square again, i.e. $16 = 4 \times 4$
Are the squares crucial? They are certainly the most 'compact'.

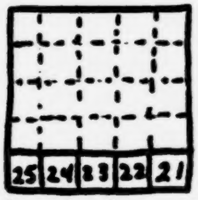
$p(15) = 16$
$p(16) = 16$

Now the next thing should be to add a row of squares onto the square of 16 squares.



$p(17) = 18$
$p(18) = 18$
$p(19) = 18$
$p(20) = 18$

Then add the next 5 squares onto the long edge.



$p(21) = 20$
$p(22) = 20$
$p(23) = 20$
$p(24) = 20$
$p(25) = 20.$

Now it is suddenly simple. It is obvious that $p(n^2) = 4n$.

The next n squares are attached in turn to one edge.

$$p(n^2 + 1) = p(n^2 + 2) = \ldots = p(n^2 + n) = 4n + 2$$

The next n + 1 squares are attached to the new long edge of the $n(n + 1)$ rectangle.

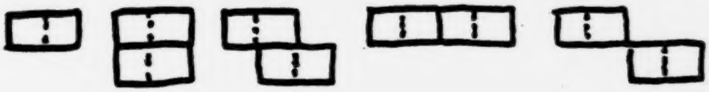
$$p(n^2 + n + 1) + p(n^2 + n + 2) + \ldots + p(n^2 + 2n + 1) = 4n +4 = 4(n + 1$$

(Proof presumably by induction!)

The idea of 'compactness' could be looked into, but not today!

What's the equivalent problem in three dimensions?

Is it a different problem if instead of squares you have 2 x 1 rectangles?



This article springs from work done at the Teachers' Center Project's summer course, 1978.

EXCERPTS

Herbert Ginsburg

Schools tend to think that they can present children with organized information in mathematics (or some other field) in a nice orderly logical way, and produce children who understand mathematics (or some other subject). This was certainly true of the "new mathematics" movement, which tried to present elementary school children starting with kindergarten with set theory, logic, and so forth and thus build up their understanding of mathematics. This may make sense to some mathematicians, although other mathematicians would even debate that. While the content may make sense to adult mathematicians, an approach like that ignores the knowledge that children bring into the situation.

The preceeding is an excerpt from "The Teacher as Researcher", a publication of the Teachers' Center Project.

Four by Four/Mystery Number

Mary Lou Sickbert

Not for children only! This is a game that can be adapted to and for any age group. The strategies applied -- and I might say discovered -- will intrigue all ages. It is a game of emerging awareness that strategies are more trustworthy and efficient than guessing.

The game consists of a game board that is placed in front of the participants.

4	12	7	15
11	1	6	14
13	5	2	10
16	8	9	3

The leader says, "Im thinking of a number. You may ask me if it's a particular number, such as: Is it 7? If it touches the sides of my number I will say,'It's hot.' If your number touches the corner of the mystery number I will say,'It is warm.' If it does not touch either the sides or the corners of the mystery number, I will say,'It's cold.' Your task is to discover the mystery number in the fewest number of guesses."

As you play this game, a pattern of discovery is evident and exciting. The finding of more productive ways adds to the FUN. One's neighbor will say, "How can you do it so quickly?"

Four by four can be made more challenging by making the game board 5 by 5 or larger. The same strategies will apply but at a different level. (Numbers can be in any order.) Individual copies of the game board could be given each participant. Watching how each child tackles the problem is fascinating.

For children who are not sure of their numbers, animals or letters can be used.

The game could be played with each participant having a ditto sheet of the game board. The child could mark in any way to help himself to keep track of the data.

This activity saw first light at the Fall '78 session of the River Bluffs Teachers' Center. Amidst a general discussion of inference in young children, Mary Lou Sickbert made a breakthrough in inventing a 4 by 4 game in which numbers touching the Mystery Number edgewise were hot, everything else cold. T.C. O'Brien then modified the activity by adding corner touching (i.e. warm). The activity is the source of considerable research among participants of the three Centers of the Teachers' Center Project, research which we hope to report in the near future.

--- T.C. O'Brien

Square Game

Kay Haas

This game was played with four first grade boys who have shown a great interest in all kinds of strategy games and thinking activities.

The rules for the game were simple. The playing board consists of 16 squares. Fig. 1 (I numbered them in sequence for simplicity.) One person would think of one of the numbers and the other players would guess one square at a time with the following responses: hot - if the guess touched the answer on a side; warm - if the guess touched the answer on a corner only; cold - if the guess did not touch a side or corner.

After each guess and response we would discuss what this told us - which numbers were possible and which numbers we could eliminate. (To make the game a little more interesting, we kept track of the number of points.) We used red bingo discs to cover the numbers as we eliminated them. Before I go on I just want to mention that everyone who guessed a number chose one in the outer circle.

At first I noticed no strategy or thinking out "shortcuts." Then I began to notice some very keen observations.

Let me take you through a game with Keith, Craig, Chris and Tony. Let's say Tony had thought of number 4. Keith may then guess number 11. I immediately ask why. He tells me that he can eliminate up to nine squares with a cold response; (Fig. 2) five squares with a warm response; (Fig. 3) and five squares with a hot response (Fig. 4) - provided number 11 wasn't the number to guess!

Naturally, he got a cold response and so our board now looks like Fig. 2 Craig then makes his guess of number 6. Quickly Chris tells him that he wasted a guess because we know 6 is eliminated. Craig explains that he knows that number 6 is out, but that he could possibly eliminate numbers 1,2,3,5,9 with a cold response (Fig. 5); numbers 2,5 with a warm response (Fig. 6) and numbers 1,3,9 with a hot response (Fig. 7).

Since his response was cold, our board now looks like Fig. 5. Now we know it is either 4 or 13. A simple guess now, no special strategy needed from here. Chris just "guesses" number 4. Three guesses.

Permit me to take you through one more game. This time Craig guesses number 9. Chris's first guess is number 6. I asked why they always guess first at the inner circle. Keith tells me that they can find out the most that way, especially with a certain response.

This time a warm response is given. Chris immediately eliminates all that he can. (Fig. 8) This leaves four possible answers 1,3,9,11. Now they could have guessed them one at a time. Tony then might guess either 2,5,7, 10 even though these are not the answers in the hopes of eliminated at least 2 at a time. In this case he guesses number 7, getting a cold response, crossing out 3 and 11 (Fig. 9) Now I ask Keith what he knows before he guesses. He tells me it's either 1 or 9. He guesses 1, gets a cold response and immediately knows it's number 9. Again three guesses.

General observations made by the"Cathedral Four:"

1. The most information could be gotten by guessing one of the 4 inner numbers first. Any response here could eliminate 9 (cold) to 12 (warm or hot) squares.

2. If there was a cold response, their next response was invariably the the other inner diagonal e.g. first 6, then 11 or, first 10, then 7. (even though these numbers were eliminated)

3. If there was a warm or hot response, their next response would try to eliminate 2 of the 4 possible answers by again guessing a number that was previously eliminated.

4. At no time after the second "game", did it ever take more than 3 guesses to determine the answer with certainty.

5. After the second "game", all first guesses were 6,7,10,or 11.

6. Using the covers to eliminate squares was most helpful as a visual aid.

7. Asking why each guess was made and what they hoped to find out after each response was most helpful to organize thoughts.

8. This game was also played on the overhead projector with the clear covers for easy manipulation.

I was truly amazed at these observations on this level. Only once was the correct number "guessed" on the first attempt.

This article springs from work done at the Belleville Area Teachers' Center during the fall quarter, 1978.

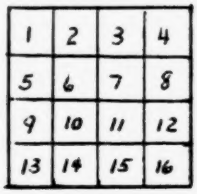

1 2 3 4
5 6 7 8
9 10 11 12
13 14 15 16

Fig. 1

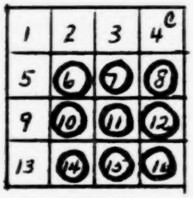
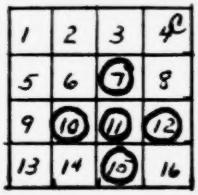

1 2 3 4c
5 6 7 8
9 10 11 12
13 14 15 16

Fig. 2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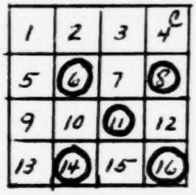
9 10 11 12
13 14 15 16

Fig. 3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5 6 7 8
9 10 11 12
13 14 15 16

Fig. 4

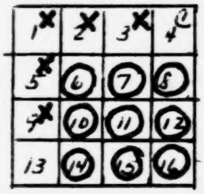
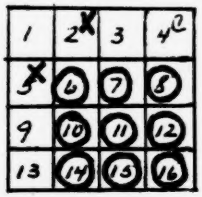

1 2 3 4c
5 6 7 8
9 10 11 12
13 14 15 16

Fig. 5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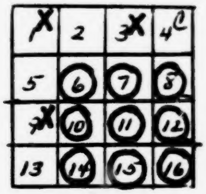
5 6 7 8
9 10 11 12
13 14 15 16

Fig. 6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5 6 7 8
9 10 11 12
13 14 15 16

Fig. 7

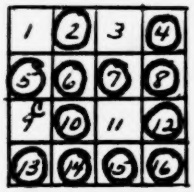

1 2 3 4
5 6 7 8
9c 10 11 12
13 14 15 16

Fig. 8

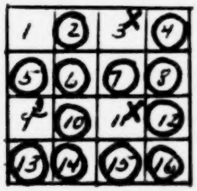

1 2 3 4
5 6 7 8
9c 10 11 12
13 14 15 16

Fig. 9

1	2	3	4
5	6	7	8
9	10	11	12
13	14	15	16

hot - on a side

warm - on a corner

cold - nothing

What kind of strategy would you use?

What is the lowest number of guesses?

What can make the number of guesses low?

What does each move tell you?

What have you learned?

EXCERPTS

John H. Bates

There are some basic premises concerning the development of kids' language. First of all, kids need models. They need a broad spectrum of models. None of us brings standard English to our situation. When kids are little, schools seem to think they have to become aware of that standardization. If they are, they have to be read to often. In all of the schools that I have been associated with on a curriculum basis (either as principal or as coordinator) there has been a demand to the staff that kids hear literature -- good literature usually, sometimes classical literature -- about 40 minutes a day. Certainly the minimum is half an hour for kids from K to 6 to sit down and read stories together, to talk about those stories if they want to, and not to be questioned about those stories. The point is that children should hear the rhythm of the language and the words of the language, and get a chance to let that bounce off their souls.

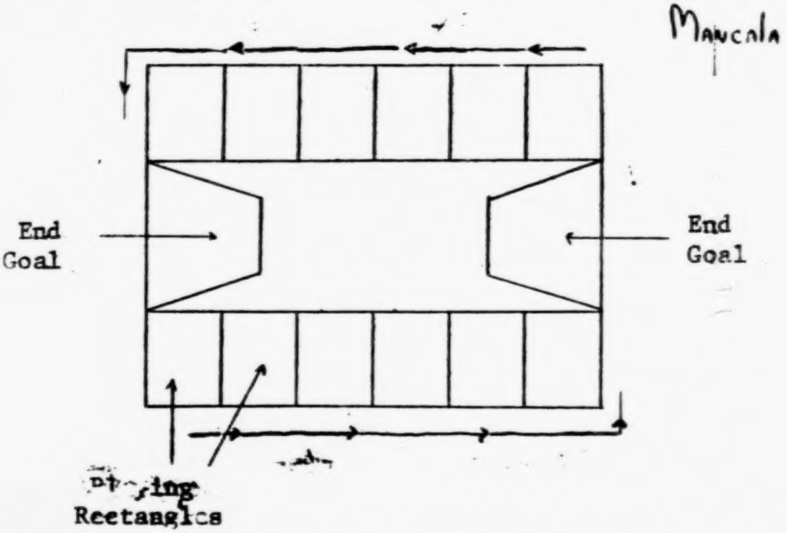
The preceeding is an excerpt from "Coaxing", a publication of the Teachers' Center Project.

Mancala

Gary Oscko

The following is an advertisement for an interesting, enjoyable and a relatively simple game called Mancala. It has its origin in ancient Africa. It can be played and enjoyed by anyone from five to ninety-five. It takes just minutes to learn but much practice is needed to understand the intricacies and the strategies of the game.

The game can be played on a board with six squares across the top and six squares across the bottom. At each end of the board will be an area known as the goal. (An egg carton will do just fine with the goal being the area outside of the carton at each end.) In each playing square three chips, tees, markers or whatever you wish to use (dry beans or paper clips are also good to use) are placed.



The playing pieces are moved in a counterclockwise direction. To win, a player must place the most pieces in his goal.

Now you are ready to start playing. The player who goes first picks up the pieces in any one of the squares on his side of the board, and places them one by one in the squares around the board, always moving in a counterclockwise direction. If, while moving the pieces, a player passes his goal, a piece is placed in the goal. There will be times when a player has picked up all the pieces in a box and as he is placing them one by one, he will go past his goal and onto the opponent's side of the board. This must be done and can, at times, be used for defensive purposes. The players alernate turns. Also, it must be remembered that when a player selects a square (only on his side of the board), he must move all the pieces contained in that square.

Free turns are given if a player, in the process of placing the pieces, has the last piece placed in his goal. This only happens when, in the course of the natural one by one placing, the last piece lands in the goal.

The game ends when one player has, by moving the pieces on his turn, cleared his side of the board. A bonus for finishing or clearing first is then given. All pieces that are still in the playing squares on the opponent's side (not his goal) are then given to the one who finished first. Each player then counts all the pieces in his goal. The one who has the most wins. One last reminder, once a piece has been placed in the goal, it stays there throughout the duration of the game.

Now, for an important question, why play this game in school? First and foremost, there are, after playing a few times, some rich thinking strategies involved in playing. The game involves problem solving, the problem being, how to outwit your opponent. Counting is involved. (Students count to see if the last piece in a square will land on their goal, thereby giving them a free turn. After the game is over, the pieces are counted to see who won.)

The game is fun. New strategies develop all the time. After playing many times myself and studying the game, I thought I had the ultimate strategy. My world was shattered when a seven-year-old second grader, beat me unmercifully. My students love the game. They want to play it all the time, recess and lunch included.

Special thanks and recognition go to Joel Ziegler who introduced the game to me. He is a former teacher who has great interest in games and their benefit to students. He has done extensive reading and research on games and he gives workshops in which he shares his knowledge with other teachers. He also makes the games himself. Joel provided from a past Teachers' Center I attended, the diagram of the Mancala game board which is included.

This article springs from work done at the East St. Louis Teachers' Center during the fall quarter, 1978.

EXCERPTS

John H. Bates

The decisions of teachers are several. What will I do today? How will I set up my room so kids will want to write? What kind of intent is there for the kid in the writing he does? Where is the child's writing going? Where is his reading going? Where is his arithmetic going? Why should a child bother to learn to add 5 and 2 when he's six years old? These are questions teachers should ask themselves. If we look at the "Why do I bother" questions, you get some pretty hollow answers from education as it's traditionally been set up.

The preceeding is an excerpt from "Coaxing", a publication of the Teachers' Center Project.

Challenge for Two

Elizabeth Thomas

Number of Participants: two

Materials Needed: Thirteen playing cards, Ace through King in any suit.

What to do? Lay out the cards face up in a row in sequence from Ace to King. Players take turns in picking up, in order, either one or two cards, starting with Ace. The object of the game is to avoid having to pick up the King. The challence is to figure out how to win every time.

Variation: This time the object is to pick up the King.

This article springs from work done at the East St. Louis Teachers' Center during the fall quarter, 1978.

Katie and the Chevrolet

Thomas C. O'Brien

What's the difference between an orphan, a bachelor, a bald man, and a monkey? An orphan has ne'er a parent, a bachelor no heir apparent, a bald man has nary a hair apparent, and a monkey has a hairy parent. A fourth grader's joke.

What's the difference between my neighbor's baby, Katie, and my neighbor's car? This time there is no joke. The question is one which anyone seriously interested in education and schools must address. Schools? Yes, we'll get to that in a moment

Katie is a two-month-old. She is discovering her hands now. She is able to bring her hands in front of her -- no more flailing around at her sides -- and she is just learning to grasp the things that fall into sight.

The car is a 1972 Chevrolet.

What's the difference between Katie and the Chevrolet? It seems at first to be a silly question, but it is not so silly. I wish to compare organisms with machines but since I am neither a biologist nor an engineer, I am limited to some simple comparisons of one organism with one machine.

Some very stark differences, once one takes the question seriously, are found just by watching Katie and the Chevrolet. Both are capable of motion -- and the Chevy is much more reliable at this than Katie -- but it is Katie who *initiates* motion. The Chevrolet just sits there -- hour after hour -- until movement is initiated by some external force.

Purpose is another thing. Watch Katie and the toy that hangs over her crib. She spots it, she grins, she reaches, she tries to grasp. The Chevrolet doesn't do much in this regard. It doesn't say, "Let's go to Montreal". It doesn't even chase after other Chevrolets.

Watching Katie work out this grasping business is really a marvelous experience. Think of the coordination involved among perception, memory, muscles, space, and time! It is Katie who organizes these things very slowly and, from an adult's point of view, very sloppily. But Katie *organizes*. The Chevy's organization was planned in Warren, Michigan, and its assembly was completed in St. Louis. For the Chevy, nothing more is going to happen along these lines, but for Katie organizing will be a central activity of her whole life.

Suppose you hold Katie in your arms and suppose for one reason or another you stumble while carrying her. Katie will startle. She will throw out her arms. She will attempt to compensate for the imbalance. She will, in short, *interact* with external reality in the interest of security and survival. On another occasion, lying in her crib with a mobile overhead, Katie will jiggle the crib to make the mobile move. Here she acts for pleasure and for a growing control over the outside world. On the other hand, the Chevrolet does not interact with external reality. Hit it with rocks, blind it with lights, flood it with rain, give it a mountain to conquer; the Chevrolet does nothing in return.

In brief, little Katie is an active entity. Even at two months, she is an initiator. She acts purposefully. She organizes and integrates. She compensates for external perturbation. She is made of parts which tend toward integration, parts which, we are told, do not really suffer replacement. The Chevy, on the other hand, is passive. It does not initiate action, devise purposes, organize the reality that surrounds it or react to external perturbation. Parts? Them you have installed at Joe's around the corner.

But there is something more. Watch Katie at random intervals. What you see is action and coordination, of course, but you also see *questing*. What you see, daily, is a movement toward greater stability and complexity and, daily as well, you see Katie engaging *new* issues. Stasis is not Katie's metier right now. Nor is to be found for some time to come.

What has all this to do with schools? The child, I suggest, is addressed by many schools as a machine, not as an organism. He is seen as a Chevrolet to be assembled and driven. That the child initiate, be active, act purposefully, organize, generally establish some sort of coherence and stability vis-a-vis his present and his future world is an issue generally ignored in many classrooms. In those instances where such activity is viewed as theoretically desirable, it is often deemed practically unattainable and, in everyday classroom affairs, it is seen as somewhat unwholesome because it *is* slow and sloppy and because it is out of line with textbooks and curriculum guidelines. Schools see children, all too often, as passive receptors of information, rules, and facts and recipes.

Why treat children as machines? One answer is that it's neat. It's also pretty economical; at least it looks that way until the long-term costs of producing obsolescent machines are compared with those of encouraging self-sustaining, active organisms. And the results are easy to measure. The question here, of course, is whether what is easy to measure is necessarily worth measuring. Suppose we have as our goal, for example, the production of reading or mathematics scores at grade level and in achieving that goal we insure that children will never spontaneously, in life to come, pick up a book and read it or that they will remain forever fearful of mathematics. Have we achieved a worthwhile goal?

Maybe children are treated as machines in part because education is itself, all too often, mechanistic. Far too often education consists of disarticulated bits and tricks thrown together without teachers' thought, teachers' reconstruction, or teachers' looks at children. The fancy word for this is curriculum. Since there is often no systematic procedure for teachers to become acquainted with new ideas and alternatives or to build collaboratively -- even with the colleague next door -- many teachers have little hunch about the purpose or spirit of the 'curriculum' they carry on in classrooms, not to say anything of possible alternative purposes and means.

Perhaps the mechanistic view of children is the result of a research tradition in psychology in which (as in memory studies involving nonsense words) meaning is deliberately banished in order to insure 'scientific' cleanliness or (as in operant conditioning studies) the object of interest is performance under various *external* conditions of reward and punishment.

Whatever the reason for our mechanistic view of children, there should be no mistake: We *can* treat organisms as machines and we *can* get them to perform as such. The question I ask as I look at Katie is, "Should we continue to do so?"

This essay originally appeared as the first of "Three Informal Essays" in Educational Studies in Mathematics (Utrecht, Holland), Volume 7, Number 1/2 (June 1976). It has been reprinted in Outlook, in the Journal of the Leicestershire Schools, and in the Journal of the Ontario Association of Teachers of Mathematics.

NUMBER CARDS

Glenda Adams

1	3
2	4
7	5
9	8

Rearrange these cards so that the columns add up to the same total. What other problems can you make?

This article springs from work done at the East St. Louis Teachers' Center during the fall quarter, 1978.

EXCERPTS

E.A. Orsborn

But the less obvious fact in some people is that if a child has a poor oral vocabulary, its chances of mastering reading skills at a good level, are considerably reduced. The child will respond to the written word much easier if he has that word in his oral vocabulary. If he knows the word to speak it, then the chance of him reading it and being able to decipher this code by its patterns or whatever, is going to be that much greater. So, when I say some people have yet to realize this, when years back -- and not so many years back -- when the children left the infant school (age 5-7) they left a place where people talked, where children talked, where there's a great deal of spoken language going on. Then they're taken, at the age of seven, into the junior class where the teachers are teaching and children have to achieve what is known as much stop talking and now they can really start learning language. This is the most ridiculous statement that can ever be made.

So, in the integrated day the spoken language must be a calculated probability where children are comparing ideas with great facility through speech. They're adding to vocabulary all the day long. So, a silent classroom in an integrated day, in my opinion, is a contradiction in terms. It doesn't mean to say that the teacher for her own self-defense doesn't choose the time when children at certain parts during the day are doing what you did this morning -- sitting down and doing something quiet. They wouldn't have been as quiet as you were, but they wouldn't have been expected to.

But the fact is that the bulk of the day, I would expect purposeful discussion going on between children and teachers. In other words, I think conversation must play the major part in any day. And this is why I wanted to raise this particular issue.

The preceeding is an excerpt from "On Literacy", a publication of the Teachers' Center Project.

Belleville Area Teachers; Center Summarizes Educational Advice

James Belter, Annemarie Garcia, Evelyn Jacob and Marie Tockstein

John H. Bates, Director of Inner City Education for the Metro-Toronto Public Schools, recently spent two days at teachers' meetings sponsored by the Teachers' Center Project of Southern Illinois University at Edwardsville.

Bates is the former mathematics coordinator for the Metro-Toronto schools and until recently he was principal of the Davenport Road School, a Toronto public school which became internationally well known for educational excellence. He is also author of the Developmental Mathematics Program published by Addison Wesley, Canada. As the result of his success at the Davenport Road School, Bates was put in charge of system-wide reform of the elementary schools of Toronto.

Here, in no particular order, are ideas shared by John Bates with local teachers as reconstructed by Teachers' Center participants who attended his sessions.

In his recent visit, Bates was mainly concerned with the development of children's language.

1. One major function of school administrators is to support and enrich what teachers do. Teachers are immensely able if you give them some support.

2. Children often don't get the chance to develop their writing abilities because so much schoolwork is done in workbooks where all the child has to do is to underline, circle, or fill in the blanks.

3. When children do write, they often feel that they're writing only for the teacher's approval or disapproval. "The teacher doesn't read it. She only marks it." said a second grade Canadian child who had just written a beautiful story about a bird building a nest. Thus, children learn quickly that writing is a distasteful chore, not a chance to communicate ideas.

4. The main job of a teacher concerned with children's writing is to invite "the expressive mode." It is important to create trust between writer and reader, something that is often accomplished when a child knows that what is written will be read, respected, and responded to. Children should be encouraged to take risks in their writing, not just produce "Dick and Jane" sort of pap.

5. Children's writing was successfully encouraged in Toronto schools by setting up a mail box system, whereby children write notes to one another (and to the teacher) in some twenty minute period during the day. The mail, addressed, is placed in a class mailbox and delivered, without the teacher's inspection, at the end of the day.

6. Teachers are under constant pressure to make children conform to adult grammar rather than to encourage fluency of oral and written language. Correctness of grammar is important, but it should follow, not precede, fluency. Emphasis on grammar can stifle fluency completely.

7. One way of encouraging correctness of grammar, as well as introducing new vocabulary and bringing about good writing habits (the fluent use of descriptors, etc.) is for teachers to read quality books to children at least half an hour each day. This is a must for Toronto teachers who work with Bates.

8. Children can enrich themselves and one another by writing books for the school library. Artistically talented children can illustrate the books. The books, bound safely in hard cover, go into the library with a card catalog entry. To make the child-author know he's succeeded, as well as to get the books more widely known, children's books are farmed out occasionally to teachers in the school -- not the child's own teacher -- whose job it is to read the book and write a short note saying something like,"I read your hockey book, John, and I like it very much." John will carry that note with him throughout the school year and the teacher will tell other children about John's book.

9. One way to correct spelling errors is for teachers to make up a list of fifty oft-misspelled words taken from children's prose (not from spelling tests) and tape them on a War Board. Children are responsible for spelling these words correctly on a test. Instead of making children responsible for all fifty words, however, the teacher calls for the child to take responsibility by marking on the top of his or her test paper the number of words the child thinks he or she has mastered. "Yes, you'll have the smartycake who puts 4 (out of 50) as the goal," said Bates, "but soon that 4 will rise to ten and twenty and fifty." Future lists should come from children's own writing, not from spelling books, because that's where spelling errors are most important.

10. The present concern over Back to Basics is attending to low level basics. To spell correctly and to memorize times tables is much less important than being able to think correctly and to communicate correctly.

This article springs from work done at the Belleville Area Teachers' Center during the fall quarter, 1978.

EXCERPTS

Hermina deZwart Sinclair

O'Brien: Can you give some examples of the young child's thinking which shows the young child as a scientist or as a beginning scientist?

Sinclair: This is always a little bit difficult when one is just talking like we are now. As you know very well yourself, the best way of getting some insight in young children's thinking is not so much to talk about them as to have them around and to look at them -- to listen to them as well, of course -- but especially to look at them. And if you want to go back to the first beginnings of scientific humans you get back to little bitty kids, i.e. babies. You can't really listen to them because they don't say very much, if anything, yet. Still, that's where one has to begin if you think of the Piagetian idea of biological continuity. If scientists are going to be, scientists are already there, practically in the cradle.

The preceeding is an excerpt from "The Child as Scientist", a publication of the Teachers' Center Project.

SEEDBED

Volume 2
Number 2
July, 1979

Teachers' Center Project
Southern Illinois University
at
Edwardsville

ABOUT SEEDBED

It's a very great pleasure to be associated with SEEDBED. For one thing, SEEDBED is a success. We printed 200 copies of our first issue and ran through them in a trice. We should have printed 500. Moreover, we have evidence that SEEDBED is being passed from hand to hand not only in the SIUE area but throughout the US, in Canada, and in UK.

Success aside, it is simply a joy to associate with teachers who are thinking and acting and sharing on behalf of the intellectual well-being of children. Given the schedules -- the time, the energy, the psychic demand -- that most teachers bear (not to say anything of the vast amounts of attention they are forced to give to issues that have nothing to do with the well-being of children) the articles in the present SEEDBED are remarkable. They are all the more remarkable in the face of the present anti-intellectual (and anti-child?) climate in education, a climate marked by mindless retreat to static stuff, to memory as the prinicpal intellectual act of humans.

The success of SEEDBED and the quality of teachers' articles makes a major point. There is a great difference between macro approaches and micro approaches to education. (By macro I mean thunderbolts from USOE, one's State Department of Education or, in fact, the local Sup's office. By micro I mean the local interaction among peple and ideas at the teacher-teacher, teacher-child, and child-child level.) SEEDBED is a micro journal. The improvement of education, both in the classroom and in the nation, I suggest, can take place only at the micro level.

University City, Missouri
May 20, 1979

Thomas C. O'Brien

ABOUT THE COVER

Craig Hofmeister has just completed first grade in Kay Haas' class at Cathedral School, Belleville. Craig has been investigating the intersections of triangles. The design on the cover is one result of his work. We regret that we aren't able to reproduce the colors that Craig used so effectively.

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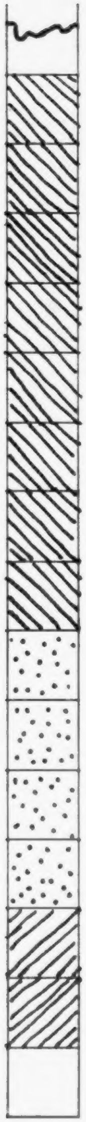
Patterns and Problems

The East St. Louis Bunch*

"Patterns"



Here's a pattern made of Unifix blocks. The pattern goes 1, 2, 4, 8.

Make the pattern.

After 1, 2, 4, 8, what comes next?

Then what?

Block 1 is white and 2 and 3 are red, then 4-7 are black, and 8-15 are black. Then the colors repeat.

What color is the 20th block? the 50th? the 100th?

---

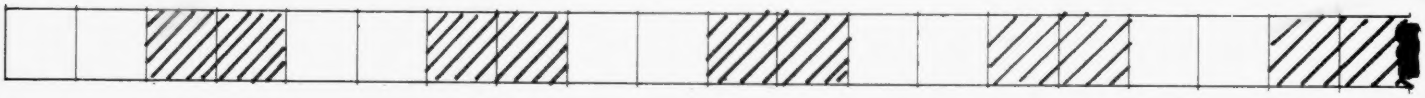
*Glenda Adams, Bobby Bean, Rosa Danner, Mable Davis, Edna Greer, Gary Oscko, Adell Stephens, Elizabeth Thomas, Diann Williams, Lillian Williams.

These problems spring from work done at the East St. Louis Teachers' Center during the winter quarter, 1979.

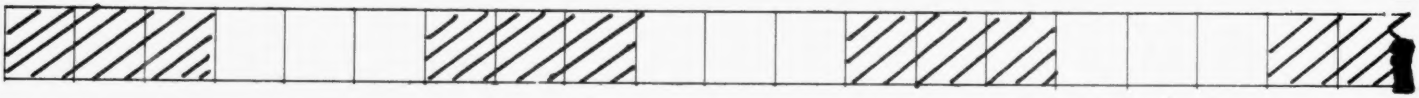
More on Patterns

On the previous page, you may have seen some problems involving patterns. The pattern shown is not an easy one and the issue is not one for beginners. Now is your chance to make up some problems for your own children at their level. What problems can you make up to deal with the following patterns?

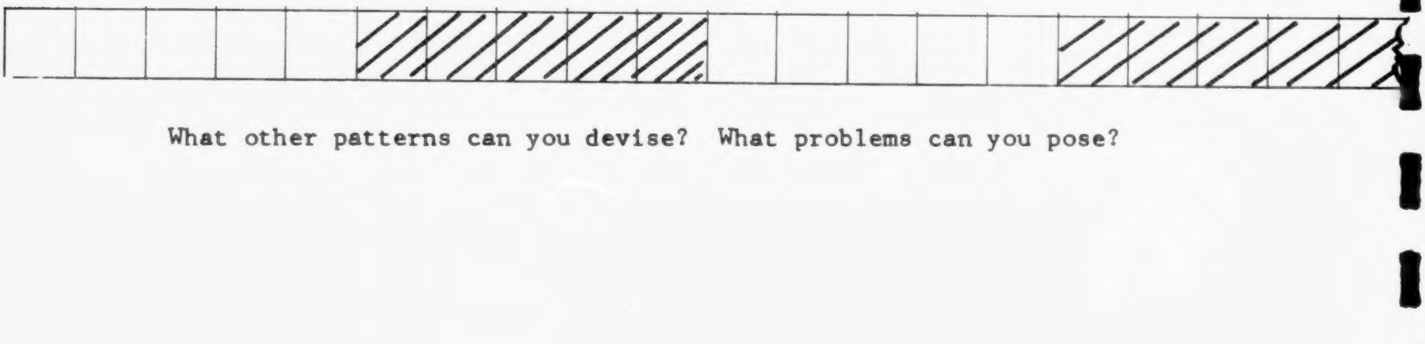
The 2's table



The 3's table



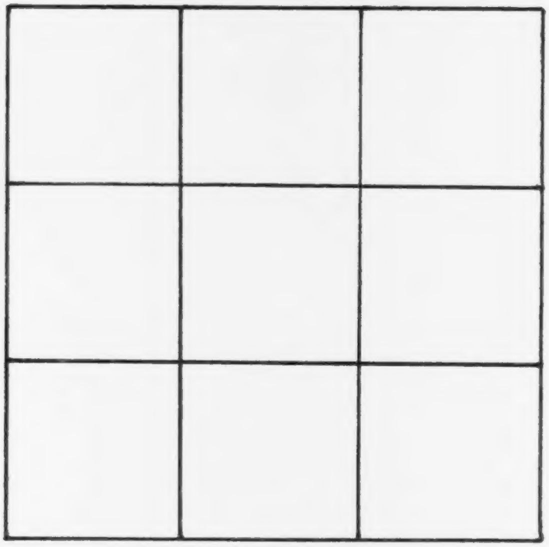
The 5's table



What other patterns can you devise? What problems can you pose?

Pattern Square

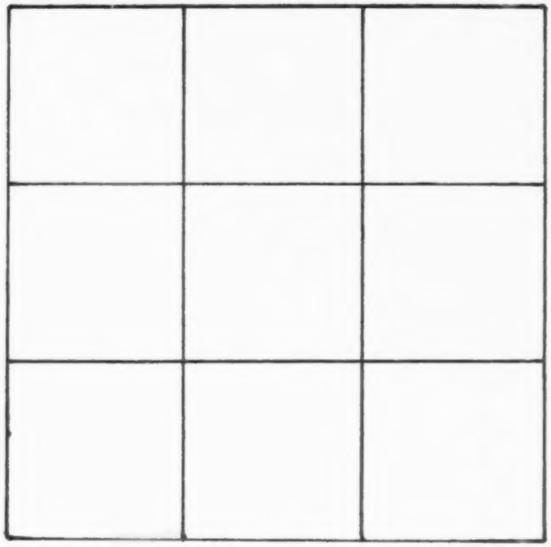
Make nine one-inch squares and put the numbers 1-9 on them. Place the numbers on the grid below so that the eight sums - three columns (↕), three rows (⟷) and two diagonals (⤡ and ⤢) form a pattern.



What patterns can you find?

Not - So - Magic Square

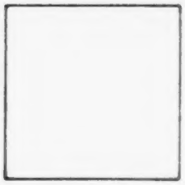
Make nine one-inch squares and put the numbers 1-9 on them. Place the numbers on the grid below so that the numbers add up to eight different sums - three rows (⟷), three columns (↕) and two diagonals (⤡ and ⤢).



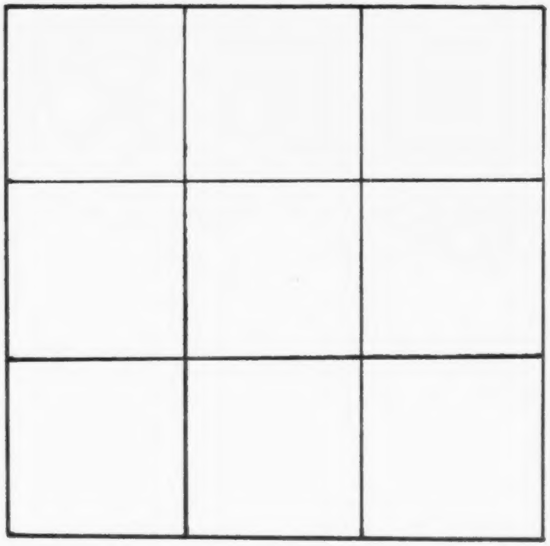
Once you have done it, try for a different one. How many can you get?

Magic Squares

Make nine one-inch squares like this:



Put the numbers 1-9 on them. Place the numbers on the grid below so that the numbers add up the same in all rows (⟷), all columns (↕) and both diagonals (⤢ and ⤡).



Once you have done it, try for a different one. How many can you get?

Cats And Dogs

Can you change a cat into a dog? Of course you can.

cat → cot → cog → dog

Try the following changes. You are allowed to change only one letter at a time and all words must be real words. (The dictionary is the reference.)

cold → warm

kitty → tiger

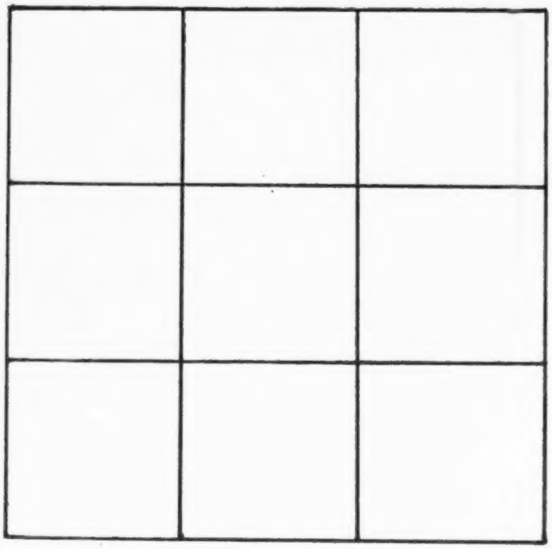
love → hate

small → large

Make up some of your own.

Touching Squares - I

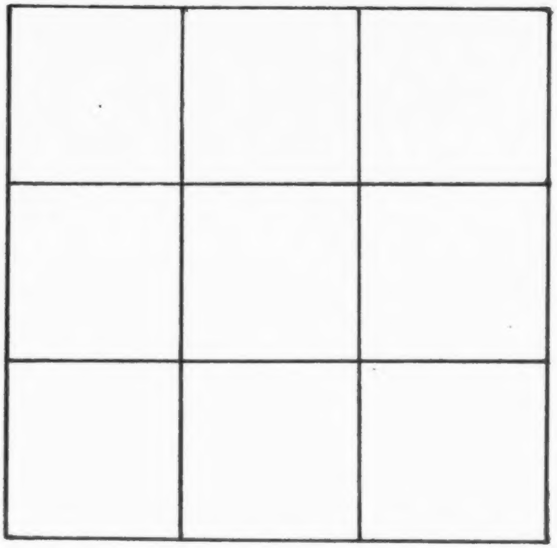
Make nine one-inch squares and put the numbers 1-9 on them. Place the numbers on the grid below so that no two consecutive numbers are edge-touching.



How many ways can you do it?

Touching Squares - II

Make nine one-inch squares and put the numbers 1-9 on them. Place the numbers on the grid below so that no two consecutive numbers are touching, either edgewise or cornerwise.



What do you think? Prove that you are right.

Birds And Horses

Can you change a bird into a horse? (You can change a cat into a dog by going cat → cot → cog → dog.)

In changing a bird to a horse, you can change or add one letter at a time. All the words you use must be real words. (The dictionary is the reference.)

Here are some others to try:

cat → mouse
love → despise
dad → father
dog → gift

Pyramid - I

Here are some headings for lists:

- things that fly
- things used in cooking
- things found in a kitchen
- things associated with Christmas
- things that are often hot

For each heading, make up a list of things that fit the heading.

Pyramid - II

Here are some headings for lists:

- things that fly
- things used in cooking
- things found in a kitchen
- things associated with Christmas
- things that are often hot

Make up some headings like this. Then choose two children in your class to play Pyramid II. Give one heading to one of the children. His/her task is to name things that belong to the list (without using any word given in the heading). The second child's task is to guess what the heading is.

Time pairs of children. The pair with the shortest time is the winner.

EXCERPTS

Herbert Ginsburg

There is no cookbook or formula guaranteed to provide success in teaching math. However, there are some things teachers can do to help children like school learning better:

It is natural to think first of testing when a new school year starts. One must go beyond standardized testing, which has a very limited value. It can only give you a rough idea of students' class rank or percentile. The teacher already knows where the students stand in class so the test results aren't needed. Also, many children misunderstand the directions or don't test well. Most importantly, the tests don't tell you how the child goes about doing things. At worst, they mislabel children, discriminate against minorities, dominate the curriculum, and pollute the school atmosphere.

Why not try, instead, testing children in an informal manner. (This is much cheaper than standardized testing- a fact which should appeal to any budget committee!) Get to know the child by interviewing him and discovering what he does well. Have the child "think out loud" while doing a problem. Then, you can find out his mathematical reasoning ability. By probing and using flexible questions, a teacher can look for a deeper meaning behind children's errors; for errors aren't capricious but made for a reason and always have a meaning. This method allows teachers to observe and theorize about children first; then structure the curriculum to fit, rather than the other way 'round.

Once the specific roots of mistakes are known, we need to encourage whatever form of learning seems appropriate for the children. For example, some of them may be using faulty lining up methods, adding sideways incorrectly, or failing to memorize facts properly. Therefore, drill or rote might be required; at other times, reading or work with manipulatives. There is no dominate mode. If a method doesn't work with a particular child, don't give up on the child - abandon the method. Some students need texts, some need games, and still others need worksheets. If the text has to be covered during the year; then supplement with other approaches for individual children. Try to build on their strengths, as shown in the informal interview.

Show children how school arithmetic relates to their own, which they have already developed. Meaningful activities are counting, combining objects, using informal notions of more and take away. The ideas introduced in school must relate to their ways of understanding the world of quantity.

One of the weakest areas in school arithmetic is the difficulty in understanding written symbolism. Children can speak English before learning to write it and can also understand arithmetic before writing it. Therefore, it isn't fair to judge children's arithmetical knowledge from their use of the written symbols. They are quite adept in informal arithmetic and functionally illiterate in their use of written numbers. Notation must always be related to concrete experiences. Instead of using mathematical language, "take away" and "altogether" should be used. These terms get the point across and may help to bridge the gap between informal and written arithmetic.

Help children to perceive the world of mathematics by reducing the tedium of calculation but understanding the behavior of numbers. They don't need to memorize tables, for instance, as they can easily construct them on their fingers. Electronic calculators are one of the few mathematical devices that children enjoy. Why not use them for computation? Also, give them exercises in perceptual learning; where they use numbers and must guess the function or relationship. Let's relieve children of some of the calculational burdens so they can see what exists in the world of numbers.

Remember that genuine learning disabilities are rare. Low IQ's or low math aptitude are useless explanations. Every child by age 5 or 6 has the intellectual ability to learn basic mathematical ideas. This competence is what we always should keep in mind.

The preceding is an excerpt from Children's Arithmetic - The Learning Process, by Herbert Ginsburg (New York: D. Van Nostrand, 1977). This book is available through the Teachers' Center Project.

Solar Eclipse - Seeing is Believing?

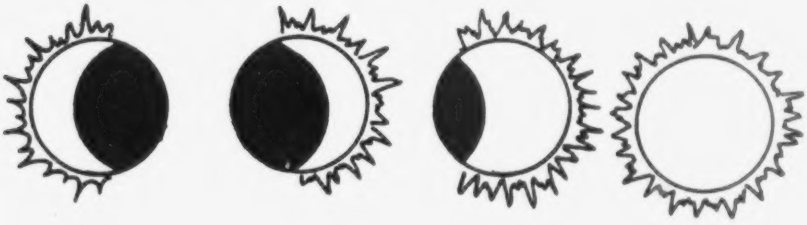
Barbara Sokolowski

Do children really understand what they see? Piaget's work has told us that children transform what they see into their own internal structure. They even go as far as changing reality to fit comfortably into their existing logical structure to explain what they have seen and why it is so. The recent solar eclipse provided a first-hand example of what Piaget has discussed about children's distortion of reality.

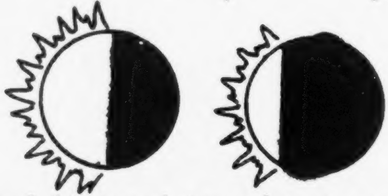
On February 26th my fifth grade class observed the solar eclipse using paper with a pinhole in it; the image was shown onto another piece of paper. They observed the sun forming a perfect circle before the eclipse began and watched, deeply engrossed and fascinated, as the moon steadily progressed across the face of the sun.

Later that same day I asked the children to paint what they had seen on large pieces of white paper. Most of them did paint a copy of what they had seen in one stage of the eclipse or another. However, there were several paintings which so drastically distorted reality - what they had viewed just a few hours earlier - that I was amazed - here was Piaget's observations of children's assimilation - alive and real - in my own classroom.

Here is what was actually seen by the children:



Here is what was reported by the children:



For these children who had listened to a lesson on eclipses, had seen drawings of what would be seen, even their own first-hand experience did not provide enough evidence and proof to override their prior ideas and understandings about an eclipse.

There must be something said as to assuming understanding in the child when she/he can so distort reality even in the face of personal experience to the contrary.

My reaction? Surprise and a sense of wonder. It points out in striking terms what I as a teacher must not distort - reality. I must not assume that understanding will necessarily follow my lesson - even a well-prepared one. Nor can I expect all children to reconstruct what she/he has been exposed to. Furthermore, I can not blame the child's lack of interest and inattentiveness for lack of understanding.

What a nice feeling to look aroung my classroom and realize that these little people are sharing their growing with me. Thanks, Sun. Thanks, Piaget.

This article springs from work done at the River Bluff Teachers' Center during the winter quarter, 1979.

It May Seem That Way, But TV Isn't A Surrogate Parent

Captain Kangaroo

Back in the old days, when I was a child, we sat around the family roundtable at dinnertime and exchanged our daily experiences. It wasn't very organized, but everyone was recognized and all the news that had to be told was told by each family member.

We listened to each other and the interest was not put on; it was real. Our family was a unit and we supported each other, and - we were even willing to admit - we loved each other.

Today, the family roundtable has moved to Burger King and talk is not easy, much less encouraged.

Grandma, who used to live upstairs, is now the voice on long distance, and the working parent is far too beaten down each day to spend the evening relaxation time listening to the sandbox experience of an eager four-year-old.

So family conversation is as extinct as my old knickers, and parental questions such as "What have you been doing, Bobby?" have been replaced by "I'm busy, go watch television."

And watch TV they do; count them by the millions.

But it's usually not children's television that children watch. Saturday morning, the children's hour, amounts to only about 8 percent of their weekly viewing. Mister Rogers, The Electric Company and Sesame Street nurture many, but not nearly so many as are exploited by the theatrical releases of a quarter-century ago - still found on local television - with their foolish stereotypes and inane behavior models.

But wait! I've saved the largest children's audience for last. Where are they to be found? Watching adult television, of course, from the Match Game in the morning to the afternoon at General Hospital, from the muggings and battles on the evening news right through the family hour and past into Starsky and Hutch. That's where you find our kids, over five million of them, at 10 P.M., not fewer than a million until after midnight! All of this is done with parental permission, albeit implicit.

Television, used well, can provide enriching experiences for our young people, but we must use it with some discretion. When the carpet is clean, we turn off the vacuum cleaner. When the dishes are clean, the dishwasher turns itself off.

Not so the television, which is on from the sun in the morning to the moon at night and beyond!

Parents must exercise some control and show some concern about the cultural influence on the child when a program not intended for that child is viewed. Parents need to intervene. Nonintervention may be a laudable policy in international affairs, but the results of parental nonintervention will not be applauded at the United Nations or anywhere else.

A child's television viewing should not be filling the vacuum created by a parent's neglect.

A child needs to be listened to and talked to at 3 and 4 and 5 years of age. Parents should not wait for the sophisticated conversation of a teenager. By then, communication will be impossible because love will have passed both parent and child by. An hour or two of high-quality time, given consistently, will be a daily bouquet of love - and a message well received be a real human being.

Reprinted by permission from the February 10, 1979 issue of the New York Times.

Prediction in the Inference Game

Kay Haas and Shirley Casey

1	2	3	4
5	6	7	8
9	10	11	12
13	14	15	16

A 4 x 4 grid with numbers in each square is used in the Inference Game. The leader thinks of one of the numbers (which we'll call the hidden number). The other player guesses which number it is. S/he receives one of three possible responses (unless s/he is incredibly lucky and guesses the correct number).

Hot - the guessed number touches the hidden number on an edge.

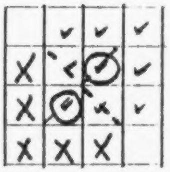
Warm - the guessed number touches the hidden number on a corner.

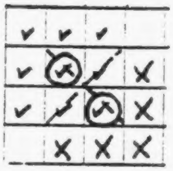
Cold - the guessed number doesn't touch the hidden number at all.

S/he continues guessing (but no longer completely at random) until s/he can identify the number with certainty.

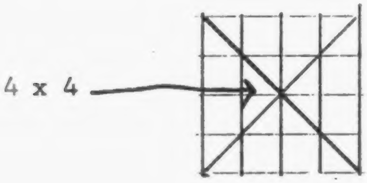
We tried to see what the fewest number of guesses would be if we played keepaway. (Keepaway is defined as a game that involves no luck -- cold answers are given as long as possible and then answers are given to make the greatest number of possible guesses necessary.)

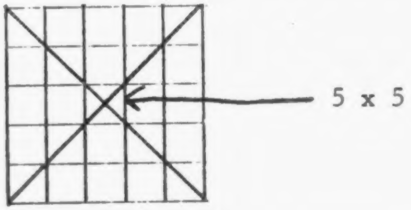
We noticed that any one of the four interior squares gave information about 9 of the 16 squares and by asking about the interior square diagonally opposite the first one guessed, we could eliminate 5 of the remaining 7 squares (so the pair eliminates 14 squares). Adjacent pairs of these interior positions only eliminate a total of ten squares. We hypothesized that these "interior diagonal squares" would continue to be important.





Something led us to look at the 5 x 5 to see if we could predict how many questions are needed. Was this number related to the number of internal diagonal squares as had been noted in the 4 x 4? We noticed immediately that there were five interior diagonal squares - in an "X" configuration and that now some of them were paired as in the 4 x 4, but one was not -- the intersection of diagonals of the big square fell in a small square rather than at an intersection of small squares as had happened in the 4 x 4 squares.

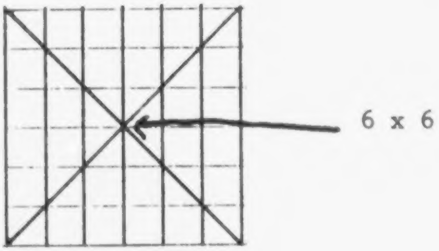




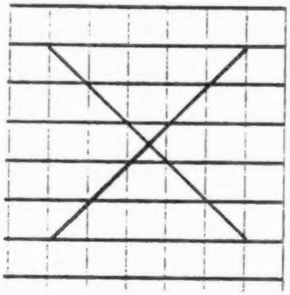
We played the game on the 5 x 5 and began to keep a record of our findings. We hypothesized that 5 questions would be needed because there were 5 interior diagonal squares.

? x ?	Number of Internal Diagonal Squares	Total # Squares	# Questions to certain Identification
4 x 4	4	16	4
5 x 5	5	25	6

Why is it six instead of five? Since we couldn't answer the question, we needed to look further at the 6 x 6.



There was an even number of interior diagonals and the "X" that they formed had its cross at an intersection of squares. We played the game and it took 7 questions or guesses. What about the 7 x 7?



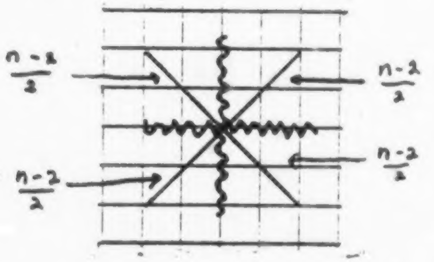
It does cross in a square and it took 9 questions. Can we use what we know to predict?

? x ?	Number of Internal Diagonal Squares	Total # Squares	# Questions to certain Identification
4 x 4	4	16	4
5 x 5	5	25	6
6 x 6	8	36	7
7 x 7	9	49	9

About this time we saw a pattern in the Number of Interior Diagonal Squares column (+1, +3, +1, +3, ...?). We decided to cut some squares out of graph paper to check on whether or no the pattern continued. It did (as far as 13 x 13) and the old question surfaced--WHY???

We noticed that $\frac{n - 2}{2}$ was the number of interior diagonals per leg of the X in even configurations (where n = side length of the total square). The n - 2 was true because we only considered interior diagonals and /2 because no leg extends into the other half of the large square.

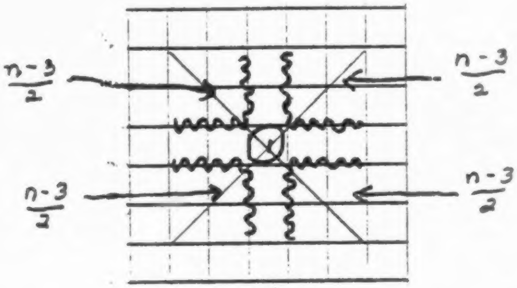
Having done this, we immediately saw that this was also true when the square was bisected the other way.



AHA--four legs--each in a different quadrant--therefore

$$4\left(\frac{n-2}{2}\right) = \text{Number of Interior Diagonals}$$

Now to a square of odd configuration:



We still needed to consider the internal diagonals only so n - 2 was where we started. But the fact that the intersection of the diagonals fall inside a small square meant that that square wasn't completely in any one quadrant. We decided therefore not to consider it at this point. $\frac{n-3}{2}$ was the number of internal diagonal squares in any quadrant. Four quadrants called for $4\left(\frac{n-3}{2}\right)$ but now we needed to add on the square in which the intersection fell. So: $1 + 4\left(\frac{n-3}{2}\right)$ is our formula for the number of internal diagonals squares in a large square whose side length is uneven. It fits the evidence as seen in this chart.

? x ?	Number of Internal Diagonal Squares	Total # Squares	# Questions to certain Identification
4 x 4	4	16	4
5 x 5	5	25	6
6 x 6	8	36	7
7 x 7	9	49	9
8 x 8	12	64	
9 x 9	13	81	
10 x 10	16	100	
11 x 11	17	121	

Now we realized that our Interior Diagonal tangent had taken us away from the original question, which was how many questions are needed. So we played some more.

? x ?	Number of Internal Diagonal Squares	Total # Squares	# Questions to certain Identification
4 x 4	4	16	4
5 x 5	5	25	6
6 x 6	8	36	7
7 x 7	9	49	9
8 x 8	12	64	10
9 x 9	13	81	12
10 x 10	16	100	16
11 x 11	17	121	15

What?

We looked at the chart for a LONG time and finally noticed--

? x ?	Number of Internal Diagonal Squares	Total # Squares	# Questions to certain Identification
4 x 4	4	16	4
5 x 5	5	25	6
6 x 6	8	36	7
7 x 7	9	49	9
8 x 8	12	64	10
9 x 9	13	81	12
10 x 10	16	100	16
11 x 11	17	121	15
12 x 12	20		
13 x 13	21		
14 x 14	24		
15 x 15	25		?

We continue
the +1, +3
pattern in
the interna
diagonal
column.

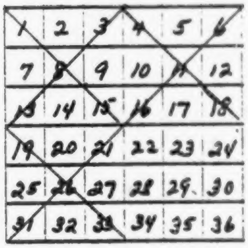
Would it be
25????

No! It's 28--three more than we expected--WHY?

We took a look at what happened when we guessed a number. The greatest number of squares we could learn about in one guess was nine. These nine squares were aligned in a 3 x 3 square. These 3 x 3 squares were important, we were sure, but we weren't sure how or why they were important yet.

We looked at any game square with this 3 x 3 square in mind and saw that we could classify all the game squares into three groups according to edge length a) multiples of 3 (6 x 6, 9 x 9, etc.), b) multiples of 3 + 1 (4 x 4, 7 x 7, etc.), and c) multiples of 3 + 2 (5 x 5, 8 x 8, etc.).

If the edge length was a multiple of 3 (as in the 6 x 6) we needed to know how many squares of nine there were. In the 6 x 6, there were 4 squares like that but since we couldn't eliminate all 36 small squares, we could only use 3 of the squares of 9(three guesses). The fourth set of 9 squares had to be dealt with differently.


1 2 3 4 5 6
7 8 9 10 11 12
13 14 15 16 17 18
19 20 21 22 23 24
25 26 27 28 29 30
31 32 33 34 35 36

Twenty-nine would be the next guess (4th one).

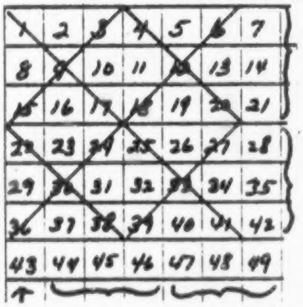
1. 29 can't get a "cold" response.

2. If 29 gets a "warm" response then 22, 24, 34 and 36. are possible. Therefore, guessing 23, 28, 30 or 35 could eliminate 2 possibilities. For example, if we guessed 23 (5th) and got a "cold" we know it is either 34 or 36. There are at least two ways of determining which it is -- but none is more efficient than the others. It takes two more guesses (6th and 7th) to identify the hidden number (as long as we play keepaway). So that is:

squares of 9 - 1 + 4 = guesses needed to identify

If 29 gets a "hot then 23, 28, 30 and 35 are possible. If we guessed 22 and got a "cold" response, we know it is either 30 or 35. Establishing which one goes as above, but the total is still 7 guesses in a keepaway game.

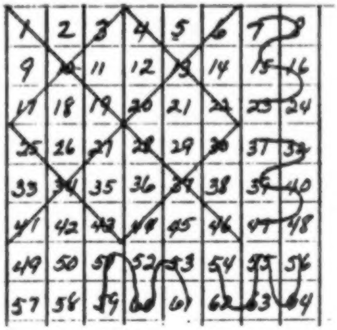
For multiples of 3 + 1 (ie. 7 x 7) we need to take out all the squares of nine we can (in this case 4 squares of nine or 36 squares). This leaves a row and a column not used.


1 2 3 4 5 6 7
8 9 10 11 12 13 14
15 16 17 18 19 20 21
22 23 24 25 26 27 28
29 30 31 32 33 34 35
36 37 38 39 40 41 42
43 44 45 46 47 48 49

These leftovers can be eliminated no more than 3 at a time and there is one left. So:

$$\#\text{ squares of } 9 + \frac{\text{total squares} - \#\text{ squares in the removed } 9\text{'s}}{3} + 1$$

For the multiples of 3 plus 2 (ie. 8 x 8)



1	2	3	4	5	6	7	8
9	10	11	12	13	14	15	16
17	18	19	20	21	22	23	24
25	26	27	28	29	30	31	32
33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48
49	50	51	52	53	54	55	56
57	58	59	60	61	62	63	64

If we eliminate the greatest number of magic squares, there are two rows and two columns left.

These can be eliminated six at a time and we end up with four squares left.

If we guess 49 and get a "hot" response, it is either 50 to 57, so two more guesses are needed to identify the hidden number. So we have:

$$\# \text{ squares of } 9 + \frac{\text{total \# squares} - \text{\# squares in the removed 9's}}{6} + 3$$

Why work with an inference problem in the first place? Inference involves the use of information not directly given.

Our work involved predicting the results of a guess and comparing power of alternative guesses. We

1) observed carefully
2) proposed hypotheses
3) looked for pattern to test hypotheses
4) expressed our patterns algebraically
5) confirmed our formulae
6) looked again at the whole problem to see if we'd made progress.

Each of these things is challenging and each of them can be worked through without extensive mathematical background. Success gives such a feeling of accomplishment.

The biggest problem we encountered was impatience to "know" the answer. We couldn't look to a "teacher" because we posed the problem for ourselves. No one was involved who "knew" the answer. So the only alternatives were to drop the problem or develop an answer. To indicate our inability to drop this, we worked (as time together permitted) over a 2-3 month period. So all we could do was struggle until we were satisfied.

We know we haven't exhaustively dealt with the problem because we focused on playing keepaway. Perhaps we haven't contributed anything to mathematics education, but we have added to our own abilities to deal with the world in a mathematical (logical) way. Maybe that is what mathematics education is all about.

EXCERPTS

Hermina deZwart Sinclair

The organism's development is epigenetic -- that's to say there is continuous interaction between the individual and the environment he lives in. The two just cannot be separated out and neither of those important capacities could at all work if there was not the fact that the individual lives in an environment.

We have this interaction between what we call the subject and the environment on which the subject brings to bear his capacities for dealing with unforeseen circumstances, for regulating his own behavior. But there is also interaction inside the subject, because the child, or the adult for that matter, doesn't progress in all possibilities of cognition at the same time or at the same rate. One learns some thing in one field, but in other fields one knows much less. There is interaction and conflict between the way you deal with problems in your own field and the way you deal with problems in something you know very little about. The environment may be the source of the conflict, but on the other hand, the subject may have raised the problem himself. The conflict arises because the problem needs a different kind of approach; an approach that the individual hasn't got yet in his repertoire.

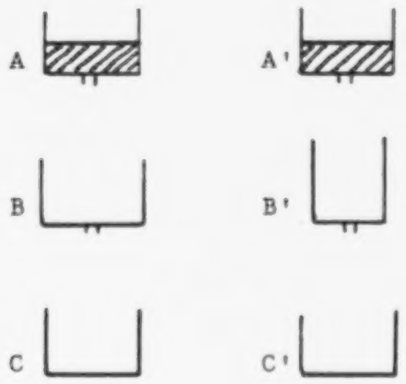
There are different rates of development in intelligence; some things just go quicker than others and some things seem to be present and then disappear. A well-known example that people are looking at again more closely is the following: The two week old infant can easily put his hand in his mouth when he wants to suck it. By two months old suddenly this seems to be a lost capacity. They can't do it anymore, and you see them looking and trying and it doesn't work. Now this is obviously not that the baby has a capacity it has now lost. It means that a whole complex of postures is getting reorganized and when you look closely at the infant, his getting his hand to his mouth is linked to certain postures. In certain postures -- lying in a certain way -- the baby can't bring his hand to his mouth: he seems to be working out a bigger complex of movements. In other postures he can still do it just as easily as before. And this is what Tom was talking about; a network of relations into which you can put something new; but also the construction of a different network into which something old has to be fitted anew. Putting your hand or your thumb into your mouth becomes a new capacity inside other kinds of capacities where you can turn your head and follow objects and even raise your head up a little bit. So there are different rates of development; certain bits of the body are ready to function before other bits and certain bits of intelligence develop quicker than other bits.

Given this biological idea of intelligence as a sort of disembodied organ -- that is, the human being's special way of organizing the world he lives in, keeping alive and happy -- this disembodied organ, of course, grows. Already in the books Piaget published about his three children, he spoke about two complementary procedures; assimilation and accomodation. Assimilation is that new things get a place inside the functioning organization of the things that aren't new, inside what you can already do, and you tend to see them through this network of relations you've already worked out so that you may deform reality in many ways. (Adults do exactly the same thing. I hear of something new and I say, "Oh yes, that reminds me of that," and I may look at this in a totally wrong way because I make it fit my network of relations where it doesn't really fit.)

Accomodation is the other complementary process. That is when you change your approach to a problem because of something new you can't deal with. You are forced to accomodate, to change your own approach. Of course, you could just leave it aside and ignore it, which happens often with children and with adults. In many Piagetian problems we've got instances where we are totally surprised that the child seems literally not to see something. I can give you an example of that. Would you like an example now to get away from all these theoretical words?

I'll simplify one of the experiments described in the book on learning. I suppose you've heard of conservation tasks? And you know that children below a certain age have great trouble understanding conservation? Have you got any idea of the feeling a child has when he hesitates, when he doesn't seem to have conservation? Can I try something on you? I'll give you two raw eggs and we weigh them and they weigh exactly the same. I'll take one and boil it and leave the other raw, and I ask you whether the hard boiled egg is going to weigh the same as the raw egg. They weighed exactly the same before. Now I don't want an answer, but I want the way you are thinking about it. I hope that you are not quite sure, and I hope that maybe you could ask me a question, which you would want to ask to be sure of the answer. But do you feel a little bit worried about this problem? If you do, that's what children feel when you have rows of chips and you spread them out or you pour liquid from one glass to the other. What I wanted to do is to get you this feeling of -- could this be the same, not the same, does something change inside the egg? Okay, now if everybody has got a feeling of this, that's the feeling the child has when you present the well-known situation of two identical glassess filled with orange juice or whatever, and you pour one into a very narrow glass and usually the child says there's more to drink where the juice goes higher up. The child does not come to this decision for purely perceptual reasons. That's one thing that is unclear in Piaget's own books because of his terminology. Perception has got something to do with it. There is something in the vertical against the horizontal. But mainly the child is acting on a theory that things that go beyond other things are longer, more, heavier, what have you. It's definitely a theory of going beyond something. Since the level of the liquid in the narrower glass "goes beyond," it's bound to be more. The child does not give a judgment like that out of the blue, or as a guess. He decides after he's had this funny feeling you may have had with my eggs. You might just have decided that the hard boiled egg is heavier. (It feels a bit heavier anyway.) Goodness knows you might have been right. I won't tell you.

One of the liquid conservation problems was done like this:



The experimenter would let out all the liquid from A to B, then he would ask the child to let enough flow out of A' so that there would be as much to drink in B' as in B. The child lets liquid out so that the level in B' is the same as that in B and there is some left in the top glass. For children of a certain stage, there is now the same thing to drink in B and B', and everybody is happy; they behave as if they did not see the liquid left in A'. Even if asked about it they will shrug off the observation and behave as if they don't see it. But the moment the liquid is then let flow into the C's where there's a difference in the level, the child says, "Oh, but you forgot that." Then he sees it. When you asked him when the liquid was in the B's, "Isn't there something funny there?" he had said, "No, no nothing." The moment it comes down and C and C' it contradicts his theory, because according to him there was the same amount in B as in B'. Now his theory has been contradicted and he looks for an out, as we all do. He only has to look up and he sees the out and he says, "You forgot that bit." But as long as the bit up there is not contradicting his theory, he acts as if he did not see it. Of course he sees it. I mean his eyes see it. But it's not integrated into his network of relationships and especially it does not contradict his theories. Now I've lost the thread of where I was - oh yes - this conflict and the way the individual has different rates of development. Successful coordination always implies reciprocal assimilation between operative schemes, and accommodation to some particular state of reality. Until this happens, the subject either shuts himself to certain features of the concrete or mental reality he is dealing with, or he experiences a feeling of conflict.

The accommodation - assimilation issue was already discussed in the early studies. Accommodation and assimilation together mean adaptation. That's the way we deal with the world. These are mechanisms that stay the same during all out intellectual development and during all our adult lives. This has not to do with the famous states; these are processes in development that have biological sources.

The preceeding is an excerpt from "Intellectual Development, Research, and Education: Excerpts from a Seminar," a publication of the Teachers' Center Project.

Act It Out

Helen Thatcher

The theory that we "learn by doing" is nothing new. It's a fact. One way of applying that principle to math education in the classroom is to "act out" stories involving logical mathematical thinking. The complaint we hear constantly is that students can compute, but they can't solve "story problems." How about helping children solve story problems simply by acting out stories at the primary level.

Here are some beginnings. The possibilities are many.

I. Family Size.

To one child say, "How many children are there in your family? Pretend your house is over there and put that many children in it."

To another child say the same thing, making the house in a different place.

Ask, "Who has more children? How many more? Who has less children?"

Have the children join hands to match families one for one to prove their answers.

II. The Birthday Party

Say to a child, "Jimmy, you are giving a party for your birthday. You invite two boy friends (Jimmy picks two boys), two girlfriends (Jimmy picks two girls), and your brother (Jimmy picks another boy)."

"How many people did you invite?" Jimmy counts two and two and one.

Then ask, "How many pieces of birthday cake must you have?" Jimmy must now include himself. "How many gifts will you receive?" Let children "act out" the cake and the gifts, using blocks or objects that they choose.

III. Riding the Bus

We are all familiar with the number game of riding the streetcar (or bus). Set up a bus by lining up chairs. Put some children on the bus. Have some get off. How many are left? Have some get on. How many now? When children reach the level of writing out their computations, they can record on paper or on the black board the numbers involved.

As children become familiar with this activity, they can make up stories for each other. Toys, such as little plastic animals, dolls, cars, can be used by a group of children to "act out" their stories.

This article springs from work done at the River Bluff Teachers' Center during the winter quarter, 1979.

First Graders Out-Strategy Teachers in Their Game

Jeanne Grinstead

"Ilkt bes imks mthk," mumbled 6-year-old Craig Hofmeister.

His first-grade teacher reminded him to take his hands away from his mouth when he talks.

"I like it because it makes me think," repeated Craig. "And I like thinking."

Thinking is the purpose of the strategy game Craig and other first-graders are playing in Kay Haas' class at Cathedral Grade School in Belleville.

Mrs. Haas in December introduced the game to the children. It is called the "Four-by-Four Mystery Number Square Game."

And it didn't take the kids long to out-strategy their teachers.

The game's playing board consists of 16 numbered squares - four across and four down. The object is to deduce the number that one person has selected by eliminating the other 15.

Mrs. Haas said Craig and three other children have taken a special interest in strategy games. They developed their own tactics when they played the square game in school. Craig's partners are 6-year-old Keith Schwartz and 7-year-olds Tony Augustine and Chris Loesche.

"These four boys love games, and they really picked up on this one," she said. "At first I didn't see any special strategy or shortcuts, but then I started to notice they were making some very keen observations."

The boys figured out a way to determine the correct answer within three guesses the second time they played the game, Mrs. Haas said.

She said their strategy was quicker and more effective than any of those thought of by area teachers who had seen the game.

"If you get it in four guesses, that's not good," Keith said. "We don't know why we like it so much, we just learned it."

One boy thinks of a number, and then responds to the choices of the others by saying only "hot," "warm," or "cold." The choice is hot if the square touches the side of the answer; warm if it touches a corner and cold if it does not touch a side or a corner.

"We learned how to take away the most numbers," Chris said. "See, if you start with a number in the middle, you knock out nine of them the first time."

Mrs. Haas said the boys do not have to guess at the answer at all anymore, because they have learned to eliminate all other numbers through inference.

She said they see the game as a problem, and have learned how to deal with it systematically and to predict the outcome.

"Their observations have been amazing for their level," she said. "It never takes them more than three moves to determine the answer with certainty."

Mrs. Haas first learned about the game at a November meeting of the Belleville Teachers' Center. The Teachers' Center Project of Southern Illinois University at Edwardsville sponsors centers in Belleville, East St. Louis, and Edwardsville as an approach to in-service education.

Excerpted verbatim from the March 25, 1979 issue of the Belleville (Illinois) News Democrat.

Three - Way Classification

Joyce Mathes

Each child is given a paper with a given word (for example, arithmetic) written vertically. Children try to find words which 1) start with one of the letters in the word arithmetic, 2) which have the given number of letters and 3) which relate to arithmetic. For example, "add" would go in column 3, line A, "angle" in column 5, line A.

This activity may be adapted to any subject area. In English, give the children a spelling word and have them fill in the blanks with related verbs or adjectives. In Social Studies, have them fill in the blanks with words learned about a country.

	3	4	5	6	7	8
A	add	area	angle		average	
R			ratio			rhombus
I						infinite
T			times			
H				height		
M			meter		measure	multiply
E			equal			exponent
T		time				triangle
I						
C		cone	carry	circle		cylinder

	3	4	5	6	7	8

STEPWISE NUMBERS

Lillian Williams

You know what odd numbers are. And even numbers. And you know what square numbers are -- 1, 4, 9, 16, 25 .... You may even have worked with triangular numbers and oblong numbers and tetrahedronal numbers. And perfect numbers. (Do you know what they are?)

But you may not know what stepwise numbers are.

The issue arose when Lillian Williams, (Dunbar School, East St. Louis) said at the March 1st meeting of the East St. Louis Teachers' Center, "I'd like the group to help me. My children are working on some number investigations." You all know that 6 + 7 = 13 and 7 + 8 = 15. That makes 13 and 15 special because they are the sum of consecutive numbers. And 15 is very special because

$$15 = 7 + 8$$

$$15 = 4 + 5 + 6$$

$$15 = 1 + 2 + 3 + 4 + 5$$

We decided to call numbers such as 13 and 15 stepwise numbers because they are the sum of consecutive whole numbers.

It is obvious that all odd numbers are stepwise numbers. It is also obvious that some numbers, such as 15, are special stepwise numbers. It is also clear that some even numbers (such as 10 = 1 + 2 + 3 + 4) are also stepwise.

The issue is under investigation, both by children and their teachers.

What can you find out about stepwise numbers?

This article springs from work done at the East St. Louis Teachers' Center during the winter quarter, 1979.

EXCERPTS

A. I. Weinzweig

So I think that the kind of understanding that people need to function in our society is quite different from what it used to be. I think that it is foolish for us to spend a great deal of time teaching children to do what they will never do in real life, things that a $5 gadget will do. The human mind is capable of so much more. It is ridiculous to clutter it with this kind of useless stuff.

The preceeding was taken from the article "Learning and Context," a publication of the Teachers' Center Project.

City Planning

Kay Haas

An interesting project for any age child is a variation of city-planning. The older the student, the more technical they can be, and the more they can expand their objectives.

I began city-planning with my first graders on a poster I received from Scholastic Magazine. Rather than just let them begin "from scratch," there were certain conditions they had to work around. The obstacles included a railroad track, a lake, a major highway and a main street. Their task was to design a practical city around these. (Figure 1)

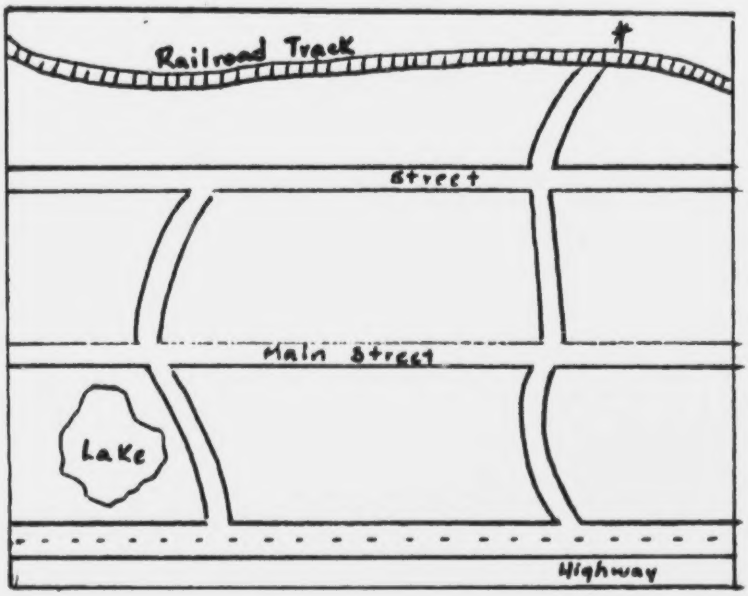


Figure 1

We used stickers of all kinds of buildings, but these can be made of paper or cardboard. The ability to move them readily is important, so we didn't draw them on the poster.

This activity was done by six boys and girls, with everyone having to approve each decision and the placement of each piece. I didn't interfere or work with them until they said they were done. Some of the arguments were so mature and more practical than I imagined they could be. I then questioned them on every move and asked the reason for their "zoning," getting some of these replies:

1. "We don't want the houses too near the railroad tracks because it's too noisy and we don't want them near the lake because a little kid could fall in."
2. "We want the school near the houses so most of us can walk." (It was decided to make the school on an inside street and to make that street one-way to lessen the danger in crossing.)
3. "Stores that we use a lot should be near our houses, like the grocery store, drug store, etc."
4. "We used low speed limits around the houses so we would be safer when we played. We even put up stop signs where we thought there might be accidents."
5. "Our town didn't have any factories, just small stores."
6. "We put parking lots by the hospital and city hall where people would need them most."
7. "We finally drew a gas station because we didn't have a sticker for one - since there were so many cars."

I found it more challenging for them having set up certain conditions at the beginning. This was an excellent problem-solving activity because it involved reasoning, decision-making, compromises and plain old common sense.

Figure 2 illustrates the city the children planned.

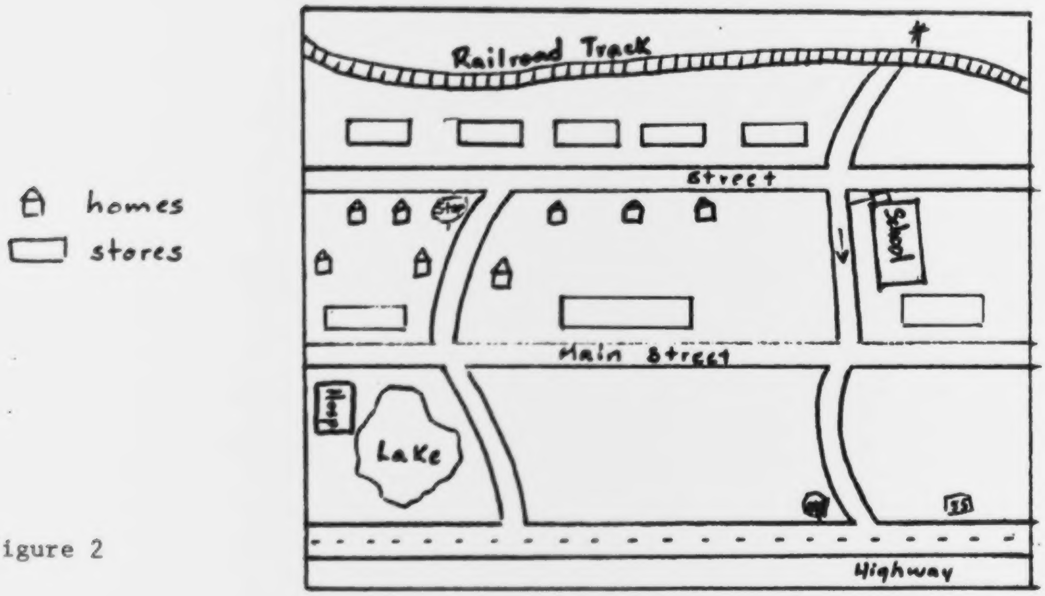

homes
stores
Railroad Track
Street
Stop
School
Main Street
Hosp
Lake
35
Highway

Figure 2

This article springs from work done at the Belleville Teachers' Center during the spring quarter, 1979.

EXCERPTS

Hassler Whitney

WHITNEY: I don't think there's a difference between doing mathematics as an adult and as a child.

O'BRIEN: What do you mean?

WHITNEY: I think it's all the same, what mathematics is is what children do. They inquire, they turn things around, they try to figure what makes things work, they try to take simple issues and look at them from various sides to see how they are made up. That's what mathematics is. Mathematics is problem solving. It makes no difference whether it's the adult mathematician or the child who does it. When a child is turning things around in his mind he is doing mathematics.

The preceeding is an excerpt from "Can Children Remain Themselves in the Classroom", a publication of the Teachers' Center Project.

Association

Elizabeth Thomas

Divide the class into teams of four or five students each. One person says a word, such as "time". Other children in the group name words associated with the category such as "hour," "second," "century," etc.

Observations:

1) Children should be given easy categories; more difficult ones tend to frustrate them or cause them to give random words.
2) The teacher should give the categories at first. Later, the children can give their own.
3) Children found this activity interesting and continued it on their own in free time.
4) Children sometimes repeat words already given, i.e. kitchen, stove, gas stove ... (Editor's Note: A variation on the same is to disallow repeats.)

This article springs from work done at the East St. Louis Teachers' Center during the winter quarter, 1979.

EXCERPTS

Peter C. Wason

I remember that my own daughters--when they went to a previous school (not the school they have now)--often had their spelling or their handwriting or their punctuation criticized. This had a damaging effect on their morales, to say the least. Just going on the basis of information from my own family, I can say that the ideas that my daughters were trying to put over were not being paid attention to by the teachers. This is not very encouraging.

Please be clear, I don't want to say that spelling is unnecessary or punctuation is unnecessary. No, I think the problem is to find the right time in which to teach these things. I think that what is far more important is that a child shouldn't feel crippled through the fear that there is precisely a right and wrong in everything they do. I'm a great believer in the value of mistakes. A person learns from making mistakes, often. The important thing in writing is to be imaginative, or--depending on the context--to be precise. It is important, I think, for students to try to express what is in their heads in a way which is apt and appropriate and also in a way which is extremely satisfying. Writing can be a very satisfying thing. I am often more satisfied when I am writing--when I finish writing--than I am after doing almost any other kind of activity.

The preceeding is an excerpt from "Research: reading, riting, rithmetic", a publication of the Teachers' Center Project.

Picnic

Edna Greer

Since it's such a beautiful day, let's go on a "picnic". Each person can take along any three things. I'll give examples of the kinds of things you can take along.

Example: grapes, balls, sweaters - Yes

sandwich, banana, soda - No

Now it's your turn - Jerry. Name 3 things.

friends (yes), hat (no), blanket (no)

If it's not in plural form say he can't take it. If a person calls all plurals, he's a winner and out of the game. The losers are in until they name plural nouns.

The object of the game is for the children to listen and hypothesize that you can only name things that are plural. (They listen to answers given and form a hypothesis.) (Editor's Note: What other rules besides plurals are possible/productive?)

This article springs from work done at the East St. Louis Teachers' Center during the winter quarter, 1979.

EXCERPTS

Dora E. Whittaker

I think that we've been segregating things as if there is one line of reasoning that is applicable in biology, another line of reasoning that's applicable in mathematics, instead of facing what I think is a fact: that nearly every subject that you take, or in every day life, we are forever classifying. So, we're saying very much so in the new approach to mathematics: it's based on classification and relations. Well, it isn't just mathematics that is. Now, I'm saying that every opportunity you give a child to reason so that he comes to some conclusion and bases it on classification and notes a relationship--whatever that subject is--that child grows.

The preceeding is an excerpt from "Implications of Piagetian Research for Education", a publication of the Teachers' Center Project.

Basic Addition Facts and a Variation in Classifying

Sharon McCormack

Here is an activity to be used for spare minutes while standing in line waiting to go to lunch or sitting and waiting for last bell.

I call out simple basic facts with names such as 4 paper clips, 2 lockers, 5 wastebaskets, and 1 door knob.

They must answer by having the sum and a label that will fit every object. A correct answer could be 12 metal objects, or 12 things made of metal, or 12 man made items. There could be many correct answers.

When some students come up with a label that does not relate in one way to all objects, another student usually calls out something to let everyone know that that label does not fit and someone else will try to answer. The students enjoy this as a sort of free exercise where no one is being graded or competing.

This article springs from work done at the Belleville Teachers' Center during the spring quarter, 1979.

EXCERPTS

Frank B. Murray

You know the whole notion that Dewey and others had of social learning, that learning should occur in groups. This again is supported very nicely by Piaget's notion of the breakdown of egocentrism as one of the principal accomplishments of operational thought. That would be found in the early book, The Language and Thought of the Child. Piaget argued, in fact, that a very good way to break down egocentric thought was to put the child in communication conflicts with other children. In fact, that probably often naturally occurs. The child runs up against other children who look at the world differently and he has to take their point of view into account. Educators, it seems to me, who have put a premium on group discussion, group activity and conflict resolution have known that for a long time and have used it very effectively. And I have some studies of my own on the issue with non-conservers. You take one non-conserver and put him in a group of two conservers and tell them that as a group they have to come up with one answer on a conservation task. Well, under that condition, they work up one answer and the conservers will win. It's not too surprising that they'll beat down the non-conserver. What is surprising, is that when the non-conserver is then tested alone later (Yes, that's the real test) and is told to say what he really believes, he has changed. In a study that we replicated, not only does he give conserving judgements, but he gives good reasons and he transfers that to items that he was not previously tested upon. He does this under a near transfer case which has the same concepts but different transformations and also on a far transfer test where the concepts are completely new.

O'Brien: And this is just the result of having worked in a group?

Murray: Right. A very brief kind of session which doesn't last more than five or ten minutes can produce that kind of change. That study has been replicated by a number of other people and so it probably is true that that process will work. And that strategy which people have recognized for a long time as a way to alter opinion and alter belief again has a nice support in the theory.

The preceeding is an excerpt from "To Tell or not to Tell", a publication of the Teachers' Center Project.

Build a Castle

Elizabeth Thomas

Material needed: Assorted building blocks

Activity: One child builds a building. As he/she is doing so he gives oral instructions to a second child whose task it is to build an identical building by following the directions given him/her. This can be done so that pupils see one another's work at first. Later, however, a barrier is erected so that the children must depend on oral directions only.

Observations: Some pupils became confused as the directions, color, ordinal placement, etc. The most difficult part of the directions was whether to stand blocks on end or on the side. Pupils became very interested in the activity and were critical of unclear directions. The activity facilitated developing and following clear, concise directions.

Editor's Note: A variation and/or extension would be for the directions for construction to be given in writing.

This article springs from work done at the East St. Louis Teachers' Center during the winter quarter, 1979.

EXCERPTS

John Pfeiffer

Gregory Bateson, widening his horizons, compares genetic and cultural evolution. He sees rigor and imagination, the two great contraries of mental process, as loosely analogous to faithful genetic replication and mutation respectively. Rigor represents social inertia, conservatism and tradition, all the knowledge that the establishment does its best to transmit intact and inviolate to succeeding generations. Imagination continually frustrates tradition; that is its function. The source of the unpredictable and the unexpected, imagination has a random quality represented by learning, not rote learning (that serves the establishment), but the sort that precedes by flashes of insight and by the questioning of assumptions and conventions. Cultural evolution, like the genetic variety, depends on the interplay of opposing forces: "Rigor alone is paralytic death, but imagination alone is insanity."

Excerpted verbatim from "Nature the Radical Conservative", a review of Mind and Nature by Gregory Bateson (New York: E. P. Dutton, 1979) in The New York Times Book Review, April 29, 1979. The review was written by John Pfeiffer.

Freedom To Learn - A Book Report

Edna Greer

Freedom To Learn portrays an active learning approach to mathematics. For children, it is an approach to learning that presents a wide variety of opportunities, an approach that encourages them to ask questions and find the answers; an approach that provides a chance to develop their individual potential.

For teachers, "Freedom To Learn" means an opprtunity to discover new and better ways of teaching mathematics. It provides an opportunity to use a highly motivated approach in developing an awareness of mathematical possibilities in the environment.

Chapter I - "Learning By Doing." Math should no longer be a rigid subject in the curriculum, but should help child to actively participate and think for himself and to develop the necessary skills. Freedom To Learn advocates Froebel's and Pestalozzi's theories of child learning by touch and sensation. As opposed to the traditional way of teaching math, there is the child-centered programs in which individual differences and developmental stages are considered in teaching.

Chapter II - "How To Make A Start." It is important for teachers to choose an approach best suited for the children being taught. Letting the children collect materials to start with makes them feel they have an important role in developing the program and encourages alertness to math in their environment. If limited by administrative restrictions, teachers tend to choose simple and slow beginnings. Some begin with no formal directions; others structure the learning situation, where various methods of grouping may be selected. If children have been restricted from investigating problems of their own, there is a period of adjustment. Children will take on responsibilities in an active learning program. Children are less hesitant to participate if given this opportunity at an early age.

Chapter III - "Classroom Needs." In using the activity approach consideration should be given to furniture arrangements and materials in classroom to allow for group interactions; partitioning for experiment area. Lack of funds may hinder the development of active learning situations. But, rather it may be the lack of imagination and initiation of teacher. A single textbook should not dominate classroom activities.

Puzzles and games require mathematical strategies. Games sharpen and develop useful skills. Weak students benefit most from games. The timely use of games can change children's attitudes toward math; audio visual aids are useful.

Chapter IV - "The Role of Teacher" makes it possible for others to learn by meeting needs of children with varying abilities. The essence of active learning is variety in approach, variety in interaction of children and variety of experiences provided for individual children. Participating in active workshops gives insight, confidence and substantial background. Schools working on experimental programs should have good communications within the community, especially with other schools where pupils transfer to or come from. These schools need to be aware of the aims and scope of work children are doing.

Chapter V - "The Role of Principal" also makes it possible for others to learn. His position and attitude sets the stage for both teacher and students educational processes which are child-centered rather than subject centered. It requires courage, determination and conviction to support innovations that will rock the boat of traditional teaching methods. The leadership of the principal should also be directed toward improved communication between home and school. There should be cooperation between principal and teachers in record keeping procedures to accommodate changes in policy. Inviting parents to school helps interpret the school program while watching the children in action. Parents can gain insight and be more inclined to support the school program.

Chapter VI - "A Typical Workshop Program" involves planned work with children in sessions in 6 week intervals with little lecturing and more opportunities to participate in active learning. Furniture arrangements and grouping are employed. Teachers often are used to traditional learning and see it somewhat difficult to shift to a more flexible active learning approach. Each group selects a topic for investigation and work up activities for children to follow. Workshop sessions end up with summarizing the math attempted during the workshop period. Time is given to participants questions on ways to encourage teachers to make a start, organize the classroom, and inform parents of aims of the program.

Chapter VII - "Math and Related Activities for Primary Grades." In developing math in the curriculum, teachers should cooperate among themselves and with the principals to ensure that mathematical education is balanced and challenging for each student. Counting and related topics are needed if children are to be involved in active learning through the multisensory individual approach. First hand experience may be gotten with one-to-one correspondence, number relationships, structural material, math notations, basic facts, computations, time, length, or tessellations. When children first come to school, they have had mathematical experiences at home, in the immediate environment. It is important for children to work with realistic situations.

Chapter VIII - "Mathematical and Related Activities for Upper Grades." Understanding the curriculum of lower and upper grades makes for cooperation in smooth transfer for primary children. Intervisitation encourages a pooling of ideas among teachers. Abstract ideas are mostly postponed to secondary school. With activities of weight and density, ratio and proportion, graphing, averages, properties of shapes, angles of triangles - all should come from direct experiences in a variety of ways.

Chapter IX - "Mathematics for the Teacher" is recognized in our surroundings - patterns in tile, dresses, scarves; in highly mechanized world such as buildings, bridges; math in homes, math in natural world; symmetry in flowers, leaves, polygons formed in mud dried cracks. Math is concerned with patterns and relationships in natural and man-made environment. Math, like science, is concerned with abstractions. We should use all means to make them more tangible.

Chapter X - "Keeping Track: Planning, Assessing, Reporting." Traditionally the measurement of students' progress has been determined by testing based on 100 point scale, which was somewhat unrealistic and arbitrary. Standardized tests are used to measure the children's intellectual development. Rather than teacher's judgment and standardized objectivity, evaluation must change to a more flexible progress reporting of the children. This includes planning students' progress - principals and teachers coming together to plan a basic curriculum; assessing student's progress in ability to compute, understanding concepts, way students arrive at answers, self-assessment. Progress reporting requires good understanding between teachers and parents, not only by report cards, phone calls or notes but frequent visits showing mutual concern. Frequent glad notes should be sent home, frequent short telephone conversations praising the child.

Chapter XI - "A Look at the Future." Active learning bridges the gap between traditional teaching and a child-centered flexible program. Math was used to show how that gap can be filled. Rigid curriculum causes children to lose interest. Teachers who began working in a more creative way with math and science found the approach contagious and soon spread to other areas of curriculum. Teachers can not only communicate with each other, other schools, but across counties and countries.

EXCERPTS

David S. Fielker

One way of looking at all mathematics is to suppose first that it is based on the ideas of sets--if you like, the idea of classification. Second, there is the idea of relations--relations between members of the set or between two sets. And third, there is the idea of operations. An operation is a way of taking two members of a set and combining them in some way to give you a third member of the set. Now if we look at the topic of number for a moment (because teachers are more familiar with numbers than they are with geometrical entities), then we have sets of numbers like whole numbers, even numbers, odd numbers. We have subsets as well--fractions, negative integers, multiples of three, square numbers, triangular numbers that we just mentioned; all these are sets of numbers. So we classify numbers in this sort of way.

Now everybody is familiar with operations on numbers. There are usually four of them (although I would sometimes dispute that), and these are addition, subtraction, multiplication, and division (usually in that order, but not necessarily). These are ways of taking two numbers and doing something with them, like add, to produce a third number. (There are some occasions when you take two mathematical entities and combine them in some way and you produce a different sort of thing. For instance, if you multiply two vectors using the operation of scalar product, you produce a number and not a vector.) Now relations between numbers we don't do very much on. A lot of fuss is made about the inequality of numbers with young children, but not quite so much fuss is made about other relations between numbers like "is double," or "is the square of." Then you produce inverse relations like "is half of," or "is the square root of." And one can, especially with older children, formalize this idea of relations and inverse relations and get far more out of it.

Whenever you have a relation between two numbers, you have an inverse relation. And usually we leave out the inverse relations. All right, so I'm talking about relations between numbers. We have operations on numbers, and we can classify numbers and have sets of numbers. So there are three basic ideas which underlie the whole of mathematics--sets, operations, and relations. And not necessarily in that order.

Now we don't do much about that in geometry, but we can do something. For instance, we can put things into sets, and this is often done with shape. We can have sets of shapes. We can classify polygons into triangles, quadrilaterals and classify them according to the angles they have, according to how many sides are parallel, and according to symmetry (which is probably a much better way of doing it). So we can apply the idea of sets to geometrical entities. But the trouble is it's always shape and yet you see I was talking about sets of straight lines or sets of points. And it seems to be just as profitable, if you think about it in that sort of way.

Now if you take the idea of relations, there we are much more used to the idea of a relation in geometry. We have relations between shapes. Certainly we have a relation called similarity. This is one of the main relations we use in geometry, particularly later on. And we have the idea of congruence. It's a relation, in the sense that you can pick one shape up and fit it exactly on top of another. This how Euclid described congruence. This is a relation between two shapes or, if you please, between a shape and itself. And symmetry also has something to do with relations. Either the symmetry of a shape, where you are fitting a shape into its own frame, or observing the relation of the shape to the frame you draw around it, perhaps in terms of the movement you make in order to fit it in in different ways. Or just the basic idea of symmetry as a relation between pairs of points. And one can make this very vivid for children by working with the pegboard and playing a game. You play with one child, or two children play. One of you puts a peg in the top left hand corner, the other one puts a peg in the right hand corner. Each peg is matched by a peg on the other side. And you build up bilateral symmetry. You get some funny things happen up to the age of six or seven, because you can match to a certain extent, and then you come downwards. A child will match, and then you go inwards and see what happens.

The preceeding is an excerpt from "Teachers, Elementary School, and Geometry", a publication of the Teachers' Center Project.

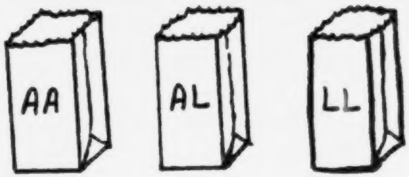
The Three Bags Problem

Lois Daesch

Six pieces of fruit are distributed among three bags such that each bag contains 2 pieces of fruit. They are labeled AA(two apples), LL(two lemons), and AL(one apple, one lemon). Each bag is mislabeled. No bag contains what the label says it contains.

How can you reach in one bag, pull out one piece of fruit (no peeking) and tell for sure what is in each bag?

I presented this problem to my fifth grade class. Many children immediately said, "You can't do it." Others tried and said the same. Many continued to verbalize. Some drew the sacks,



and labeled them $\frac{\text{AL}}{\text{LL}}$; $\frac{\text{LL}}{\text{AA}}$; $\frac{\text{AA}}{\text{AL}}$ putting the possible correct labels under each.

The child who solved it, John Jakob, had just studied the mislabeled sacks on the board. He explained: "You just reach in the AL bag and if you draw out a lemon it has to be LL, but if you draw out an apple it must be AA. If you call it AA that means the LL bag can't be AA, so it has to be AL. The AA bag then can't be anything but LL because that's all that's left."

This article springs from work done at the Belleville Teachers' Center during the spring quarter, 1979.

Expert Says Kids Have Own Ideas

Jeanne Grinstead

Young children develop their own thoughts without worrying about reality, a European psychologist told SIU-E students Monday.

Swiss psychologists have theorized children construct their own knowledge rather than absorb knowledge imposed on them from outside sources, psychologist and linguist Hermina deZwart Sinclair said.

And children also make their own distinctions about the meanings of words.

The theory is a departure from the beliefs of most child development experts, who say children learn largely from outside influences.

"I think it's very good that children hold onto their theories until the moment it becomes necessary to let go of them," she said.

Their own theories and experiences cause the children to ask questions and formulate ideas about themselves and the environment.

Ms. Sinclair, one of the world's leading researchers in child development, Monday explained her theories about language and thinking to more than 40 students and faculty members at Southern Illinois University at Edwardsville.

She is a student and associate of Swiss psychologist Jean Piaget, who first published research work on the thought of children in 1926. Piaget, 84, is the director of the University of Geneva's Center for the Study of Genetic Epistemology - an organization that studies learning processes.

"The dynamic part of his theory is taken over from a biological parallel," she said. "You assimilate things from that which you already know."

For example, children perceive the action of flipping a disk into a box - as in tiddlywinks - quite differently than adults because of the contrast in levels of knowledge.

A young child asked to sketch the action will draw a direct line from the disk to the box and then draw a half-square to show it going into the box, Ms.Sinclair said. An adult would show it flipping into the box through a curved line.

The Piagetian theory states children pass through stages of mental development.

They learn of objects through their senses until about age 2, and then develop language and other skills between ages 2 and 7. From about 7 to 11 the children start to think logically, and from about 11 to 15 they learn to reason and deal with abstract ideas.

However, the researchers in Geneva are not especially interested in specific ages.

"The interesting thing is how the young children overcome their problems," she said. "We are not interested in diagnosing when children should be changing, but in the changes they experience."

Ms. Sinclair also has studied and tested children's ability to understand language and the meanings of words.

"There is a tendency among young children to think that the first word of a sentence is the one who does the action," she said. "This doesn't work for passive voice or for linguistic patterns."

For example, children between the ages of 5 and 7 or 8 think John is completing the action in both of the following sentences:

-- John is easy to understand.

-- John is eager to understand.

"John is not the actor of the verb 'to understand' in the first sentence," she said. "In the second sentence, it is John who understands."

Four-year-olds will correctly identify the actor as "I" in the first sentence and "John" in the second, she said. But they do it without reasoning, because they still think more in terms of themselves - "I" - than do older children.

The children between 5 and 7 or 8 continue to confuse syntax, or the arrangement and relationship of words in a sentence. They also do not grasp aspects of semantics, which is the study of the development and changes of the meanings of words.

Whereas many child development researchers concentrate on the young child's ability to absorb knowledge from outside influences, Ms. Sinclair has focused her work on the child's own ability to think and understand language.

"My work is helping the children to solve language problems and recognize structure," she said. "Our approach to the children's success is a mixture of syntactic and sematic properties."

Ms. Sinclair is former chairperson of the University of Geneva's psychology department and a researcher in the recently developed field of psycholinguistics.

Psycholinguistics is the study of the development of language and thought. Her research is among the most current being done in the world, said Thomas C. O'Brien, director of the SIU-E Teachers' Center Project.

The teachers' organization sponsored Ms. Sinclair's lecture at the university. She is currently a visiting professor at the Massachusetts Institute of Technology in Cambridge.

"Some of Dr. Sinclair's research on the connection between language and thought in young children won't be published in the United States for another five or six years," he said. "It'll first have to be translated from French into English, and then published here."

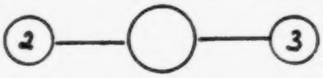
This article appeared in the April 3, 1979 issue of the Belleville News-Democrat, reprinted with permission.

A Comment on "Coaxing Children" by John Bates

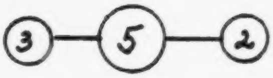
Virginia Small

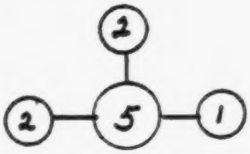
John Bates suggests to coax our children to try something new. Why should children be lead to believe the way of expressing the sums of numbers is limited? John Bates presents the challenge of a frame. Here is an exciting adventure for the minds of the children. Try this unusual approach and have the thrill of seeing and hearing the excitement of the children as they discover this limitless way of expressing what they know.

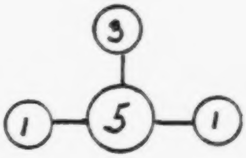
John Bates states instead of teaching the children 2 + 3 = 5 we should find out how they express 2 + 3 with this frame.

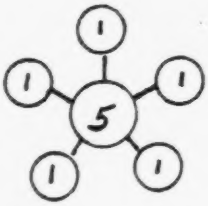


After presenting this to the children I asked, "I wonder if there could be other ways of expressing the sum of 5." The following examples show how they responded to the challenge.

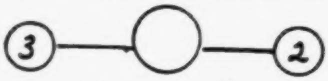




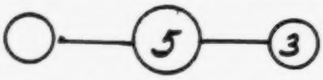




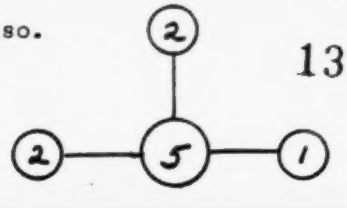
Other exciting ideas could be to have the children work in pairs, one child fill in the arms and the partner fill in the sum.



In our 1st grade class we have been working with missing addends. These frames can easily adapt to these expressions.

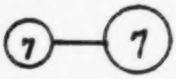


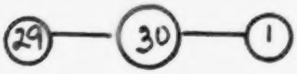
We have also been adding 3 single digit numbers and these may be expressed in the frame also.

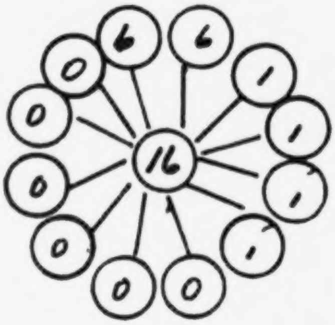


Children asked if they could use any number they wished. I said yes and these interesting results followed. Try these with your children.

These frames were made by children. Try some with your class? And have children make up their own.



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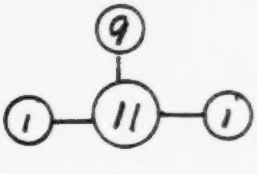

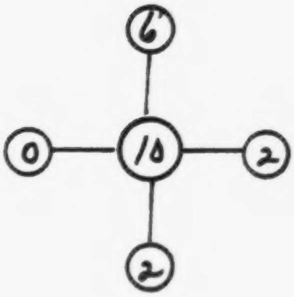

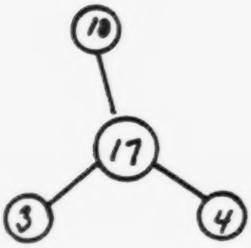

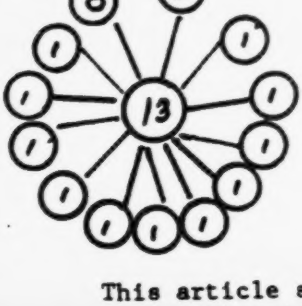
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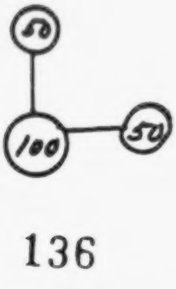
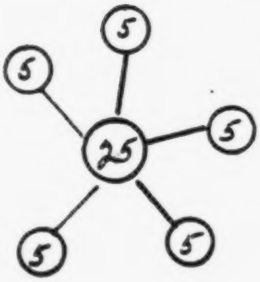




This article springs from work done at the River Bluff Teachers' Center during the winter quarter, 1979.

EXCERPTS

Geoffrey Wolff

Code law has insufficient flexibility to accomodate that delicate civilization we try to create with our children. Common law, an ad hoc determination of the merits of each pressure point between our children and ourselves, regards justice as an evolutionary process rather than as a programmed response. If code law abstracts principles, common law... celebrates the particular case.

Excerpted verbatim from "Kids, Catastrophes, and Cowboys," an article in the March 13, 1979 issue of Esquire written by Geoffrey Wolff.

Cancelling Numbers

Joyce Mathes

Make a spinner with the numbers 1 to 12. Each child needs a paper (see the attached sheet) and a pencil.

The caller spins the spinner and calls out the number. Each student crosses out two numbers in row 1 which total the number called. The caller calls the next number and the student crosses out two more numbers. When the player cannot cross out two numbers in row 1, he moves on to row 2. Once you leave a row, you may never return to it.

Caller: 7

Player: Crosses out 3 & 4

Caller: 12

Player: Crosses out 5 & 7

Caller: 14

Player: Crosses out 12 & 2

Caller: 7

Player: Crosses out 6 & 1

Caller: 5

Player: Must move on to row 2 and cross out any two numbers totaling 5

0	X	X	X	X	X	X	X	8	9	10	11	X
0	X	2	3	X	5	6	7	8	9	10	11	12

The caller keeps spinning until no one is able to cross out any more numbers. The winner can be determined by counting the digits that he crossed out.

Editor's Note:

Alternate Rules:

1) Permit crossing out of 1, 2, 3, or more numbers on each call.
2) The smallest number of crossed-out numbers determines the winner.

0	1	2	3	4	5	6	7	8	9	10	11	12
0	1	2	3	4	5	6	7	8	9	10	11	12
0	1	2	3	4	5	6	7	8	9	10	11	12
0	1	2	3	4	5	6	7	8	9	10	11	12

EXCERPTS

New York Times

Our age is known for violence. It has been marked by alienation. It has spawned bureaucracy. It has embraced cynicism. Yet human beings yearn for alternatives; they long to matter. They hunger for a community of shared values reflecting the triumph of intelligence and the life of the spirit.

* * *

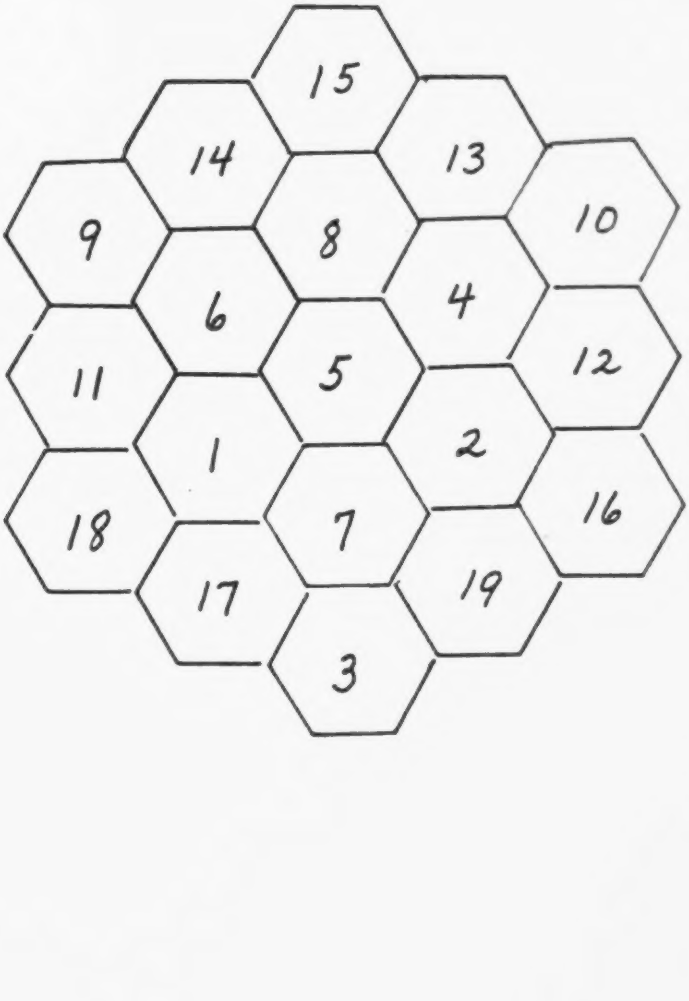
The United States is the only Western nation relying so exclusively upon advertising effectiveness as the gatekeeper of its broadcasting activities. The consequences of using the public spectrum primarily for commercial purposes are numerous, and increasingly disturbing. The idea of broadcasting as a force in the public interest, a display case for the best of America's creative arts, a forum of public debate - advancing the democratic conversation and enhancing the public imagination - has receded before the inexorable force of audience maximization.

This excerpt was taken from an article entitled "A Public Trust: The Report of the Carnegie Commission on the Future of Public Broadcasting" as it appeared in the New York Times in the issue of January 31, 1979.

Magic Hexagon

Edna Greer

This is a magic hexagon. Try to find out why it is magic.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This article springs from work done at the East St. Louis Teachers' Center during the winter quarter, 1979.

EXCERPTS

Peter C. Wason

I am inclined to think that writing is very much underplayed. There is an enormous stress on reading. But there is very little stress on imaginative writing--on writing which enables the child, as it were, to explore his or her consciousness.

Additionally, I think it is very important in view of the widely accepted decline in standards of character in writing--in fact, in language use in general whether in writing or in talking; increasingly I find people less articulate than they used to be--I think that writing has to be practiced with some degree of precision and that clarity should be exercised by the child. The child should be encouraged to write.

I think, furthermore, in the modern world, more and more things are done in collaboration with other people. I am very interested in what makes for collaborative research. At the school level, even, I am interested in how one child might help another child in not only mathematics but in the area in which I am particularly interested--writing. I think some of your teachers--I've been extremely impressed that they have in fact done this--have shown how two children independently cannot write anything particularly meritorious but if they could come together they can do a really fine creative effort.

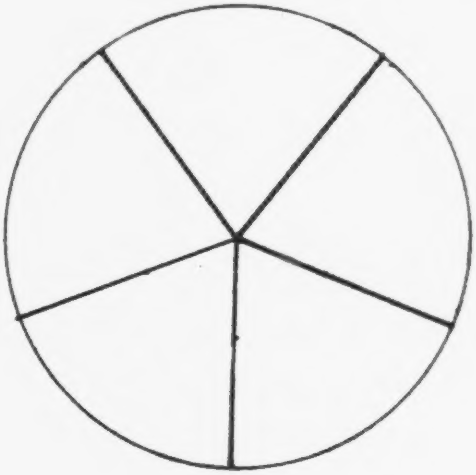
The preceeding is an excerpt from "Research: reading, riting, rithmetic", a publication of the Teachers' Center Project.

Pie Slices

Virginia Small

Number of students: 1-2

Materials needed: Paper with circles drawn on them and each circle divided into 5 sections. Each child will need a pencil.



Directions: The child (or children) is to place the numbers 1-5 in each of the sections with no two consecutive numbers touching. How many different ways are possible? Note the child's thinking as s/he works the problem.

Editor's Note: This problem provides a rich arena in which to do child-watching on the child's concept of invariance. If thirty children solve the problem, do they agree that there are thirty different solutions or do they see that there are basically two ways to solve the problem (each admitting various rotations) and that one is simply the reverse of the other?

This article springs from work done at the River Bluff Teachers' Center during the winter quarter, 1979.

COUNTING TRIANGLES IN A POLYGON

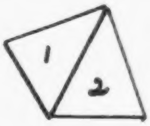
Sharon McCormack

This math experience is an extension of a project from our fourth grade book. It directed the students to draw a 4-sided polygon and apply the following rules to find how many triangles there are in a 4-sided polygon.

A. Choose a corner.

B. Draw a segment from that corner to every other corner.

C. Count the triangles.



In the project we continued to try 5, 6, 7, and 8-sided polygons. Volunteers drew them on the board and others drew the line-segments to show the triangles.

The information that we came up with was charted.

Number of sides of polygon	3	4	5	6	7	8	9
Number of triangles	1	2	3	4	5	6	

Then I asked the children to predict the answer for the 9-sided polygon. By looking at the chart, it was not difficult for many of the students to make a good prediction. One student said that the number of triangles equalled the number of sides, minus 2. The missing number on the chart was predicted as 7.

To prove their answers, each student drew a 9-sided polygon on paper, following rules A, B, and C (those given at the beginning of the lesson).

Based on what the students had learned from this project, they were able to predict answers to questions, such as, "How many triangles are there in a 48-sided polygon?"

The project ended with discussion with the students making more rules to consider, since the predictions would not come out "true" unless certain other rules were adhered to.

So, the students added two more things to consider in addition to A, B, and C from the beginning directions: 1) the students added that in drawing the polygon, no corners could point in toward the middle of the shape, and 2) there should be no intersecting lines in the polygon.

EXCERPTS

Frank B. Murray

Now with respect to the so-called formal operational period, (I say "so-called" because now there is increasing doubt that it is as formal and as general as we once thought), I am convinced now that it makes sense to talk about the decalage phenomenon in the formal operational period. Formal operations are not so generalizable across all contents. One may have hypothetical thinking or proportionality or probability or the kind of general holding-all-but-one-thing-constant strategy, but it is probably not something that one can apply universally across all content areas. Piaget's now not-so-recent paper, 1972 I think, in Human Development, argued the case that adults probably exhibit formal operations in areas with which they have had exceptional experience or in which they have been well-schooled but that they do not exhibit it in all areas. Moreover, having it, they can regress to lower levels of functioning under stress. For example, when you get a flat tire there are certain formal operational strategies you could employ to solve your problem. But you may also, if it is particularly frustrating, use some very ancient sensory-motor activity and just kick the tire or something of that sort. That's another issue: when your are competent at a high level of functioning, you may not perform for other reasons.

The preceeding is an excerpt from "To Tell or not to Tell", a publication of the Teachers' Center Project.

A RECORD OF THE YEAR'S SEEDLINGS

1978-79 SCHOOL YEAR

1. WEEKLY MEETINGS

Eighty regular sessions with teachers were held at the three Teachers' Centers: The Belleville Area Teachers' Center, The East St. Louis Teachers' Center, and the River Bluffs Teachers' Center.

2. GUEST SESSIONS

Linda Harvey, Creative Publications, Palo Alto, California; September 1978.

John Bates, Director of Inner City Education, Metro-Toronto Schools, Toronto, October 1978.

Professor Constance Kamii, University of Illinois/Chicago Circle and University of Geneva, November 1978.

Professor Herbert Ginsburg, University of Maryland, co-author of Piaget's Theory of Intellectual Development, December 1978.

Professor A.I. Weinzweig, University of Illinois/Chicago Circle- February 1979.

Robert Tappay, Educational Consultant for Scientific American, author of aha! and co-author with Martin Gardner of aha! Insight, February 1979.

Professor Hermina deZwart Sinclair, Ecole de Psychologie et des Sciences de l'Education, University of Geneva, April 1979.

Professor dr. Hans Freudenthal, IOWO, former president The International Commission on Mathematical Instruction, April 1979.

3. NEW PUBLICATIONS

SEEDBED, Volume I, Number 1, February 1979
(A journal by teachers for teachers)

"Coaxing Children," an interview with John H. Bates, Director of Inner City Education, Metro-Toronto Schools

"The Teacher as Researcher," an interview with Herbert Ginsburg, University of Maryland at Baltimore

"What Do Children Learn When They Manipulate Objects?" an interview with Constance Kamii, University of Illinois at Chicago Circle/University of Geneva

"Learning and Context," an interview with A.I. Weinzweig, University of Illinois at Chicago Circle

4. PRESENTATIONS MADE BY TEACHERS' CENTER PEOPLE

Thomas C. O'Brien, "The Intellectual Development of Children" Thirtieth Annual Meeting of the Illinois Council of Teachers of Mathematics, DeKalb, Illinois, October 1978.

Barbara Sokolowski, "Informal Research (Childwatching) of, by, and for Teachers" Thirtieth Annual Meeting of the Illinois Council of Teachers of Mathematics, DeKalb, Illinois, October 1978.

Betty Clemens and Shirley Casey, "Simple Ideas Involving Numbers" Thirtieth Annual Meeting of the Illinois Council of Teachers of Mathematics, DeKalb, Illinois, October 1978.

Mary Modene, "Number Ideas in Young Children" Thirtieth Annual Meeting of the Illinois Council of Teachers of Mathematics, DeKalb, Illinois, October 1978.

Shirley Casey, "Thinking with Mathematics -- An Activity Approach" Math Inservice Course for Dupo, Illinois,teachers, October 1978.

Thomas C. O'Brien and Barbara Sokolowski, "A Piagetian Approach to Research and Practice in Mathematics Education" Milwaukee Meeting of the National Council of Teachers of Mathematics, Milwaukee, November 1978.

Shirley Casey, "Thinking -- Language Activities" Presentation in El Ed 337, Southern Illinois University, Edwardsville, Illinois, January 1979.

Thomas C. O'Brien, "The Teachers' Center Project -- A Piaget-Oriented Approach to the Improvement of Education" Ninth Annual UAP-ASC Interdisciplinary International Conference on Piagetian Theory and the Helping Professions, Los Angeles, February 1979.

Thomas C. O'Brien, "Forward to Basics" Urbana Midwinter Conference, Urbana, Illinois, February 1979.

Thomas C. O'Brien, "Teaching for Thinking" Urbana Midwinter Conference, Urbana, Illinois, February 1979.

Shirley Casey, "Mathematics -- Thinking Activities for Teachers of the Gifted" Patterson, Illinois, February 1979.

Thomas C. O'Brien, "Intellectual Development of Children" Illinois Council of Teachers of Mathematics (Southwestern Section), Annual Meeting, Edwardsville, Illinois, March 1979.

Thomas C. O'Brien, "Mathematics and Children's Thinking" Elementary School Mathematics Coordinators of the Chicago Area, University of Illinois/Chicago Circle, Chicago, Illinois, March 1979.

Shirley Casey, "Mathematics -- Thinking Activities" Madison County Teachers' Institute, March 1979.

Thomas C. O'Brien, "Intellectual Development of Young Children" Midwest Association for the Education of Young Children, St. Louis, Missouri, April 1979.

Shirley Casey, "Teachers as Informal Researchers in the Intellectual Development of Young Children" Midwest Association for the Education of Young Children, St. Louis, Missouri, April 1979.

Thomas C. O'Brien, "Development of Children's Thinking" Association of Teachers of Mathematics, Easter Course, Worcester, England, April 1979.

Shirley Casey, "Thinking -- Language Activities" Presentation in El Ed 338, Southern Illinois University, Edwardsville, Illinois, May 1979.

Shirley Casey, "Meeting Piaget Through Selected Activities" Presentation in El Ed 420 at Southern Illinois University Edwardsville, Illinois, May 1979.

Thomas C. O'Brien, "The Teachers' Center Project: A Piaget-Oriented Approach to Teacher Education" Ninth Annual Symposium of the Jean Piaget Society, Philadelphia, Pennsylvania, May 1979.

5. RADIO BROADCASTS

A.I. Weinzweig with Jim White, "At Your Service", KMOX (CBS), St. Louis, February 26, 1979.

Bob Tappay with Jim White, "At Your Service", KMOX (CBS), St. Louis, February 12, 1979.

Thomas C. O'Brien, "Forward to Basics", Focus on Education Series, WSIE-FM, SIUE, March 13, 1979.

Thomas C. O'Brien and Shirley Casey, "Children Are Good Thinkers", Focus on Education Series, WSIE-FM, SIUE, June 12, 1979.

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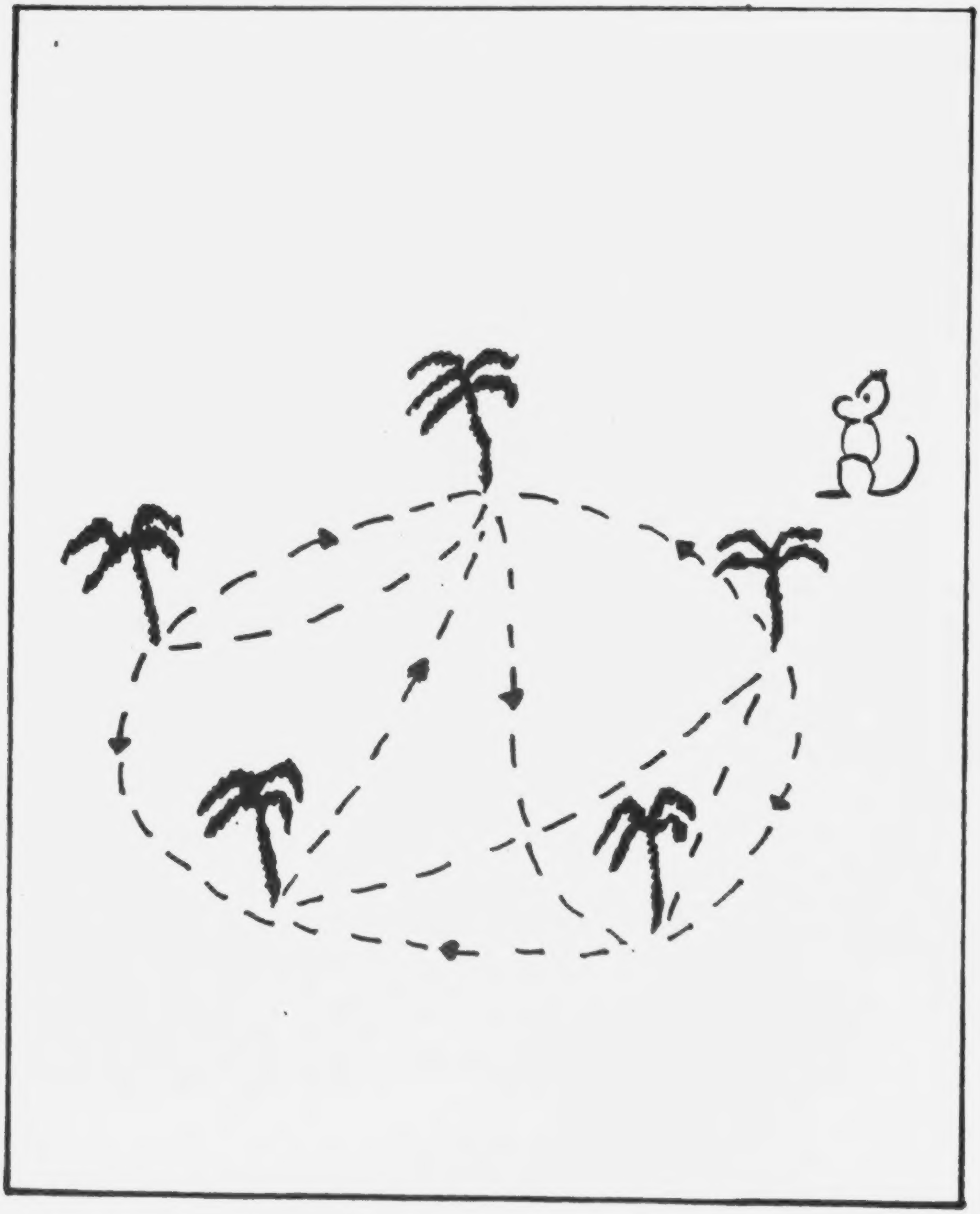

SEEDBED

SEEDBED
Volume 1
Number 3
October, 1979

Teachers' Center Project
Southern Illinois University
at
Edwardsville

ABOUT SEEDBED

1. Some tribes of American Indians, I'm told, have a great reluctance to commit things to print. When you write something on paper, they say, it loses its heart.

Many of my British friends feel the same way, especially so far as educational issues are concerned. They don't go much for the endless paperwork that so dominates American affairs. "To put things in print freezes the thing," I've heard. "It kills any life that's in it."

If these views have merit -- and I'm certain they do -- what we are doing in this third issue of SEEDBED is very risky, perhaps even foolish.

As many of you know, some thirty-five teachers from the local area and from afar gathered in August for our Eighth Annual Teachers' Center Project Summer Course. Guest "lecturers" for the course were Jan Stanfield, All Saints College, London, and Jerzy Cwirko-Godycki, Pedagogical Research Institute, Warsaw.

The course was a delight!

In the present issue of SEEDBED, we share some of the problems and activities and investigations of the course as well as -- more important -- some of the offshoots that participants themselves developed as a result of the course.

There is no doubt that what's here in print has less heart than the rich give-and-take and growth that took place during the course. So it's up to you, the reader, to give the issues heart by making them your own, trying them out with children, and extending and elaborating them yourself.

2. Summer course number 9 is already in planning, by the way, the dates are July 28 - August 2, 1980.

3. Great thanks to Shirley Casey for handling much of the editing of SEEDBED, to Jan and Jerzy for the seedlings you see sprouting here, and to all the kind folks who made the summer course such a success.

4. And apologies to the reader and to some of the course participants, because for reasons of space and over-coverage of topics not all the articles submitted appear here. SEEDBED is less for that.

5. One of the major aspects of Summer 8, aside from the immersion in Jan and Jerzy's seminal thinking and the participants' seedlings herein, is the fact that Jerzy has asked the Teachers' Center Project to be North American disseminator of his work cards (disseminated in UK by the Association of Teachers of Mathematics). This we are delighted to do. Inside we include a small sample of Jerzy's work; a separate publication, forthcoming, will be given entirely to Jerzy's work.

Edwardsville, Illinois
October 1, 1979

Thomas C. O'Brien, Professor

ABOUT THE COVER

What's it all about, the monkey and the pathways on the cover? It's a problem posed by Dr. Jerzy Cwirko-Godycki at the Eighth Annual Summer Course of the Teachers' Center Project. Here's the problem:

> *A monkey travelled from palm tree to palm tree as shown in the diagram. Where did he start? Where did he finish? Can you make up other Monkey Problems yourself?*

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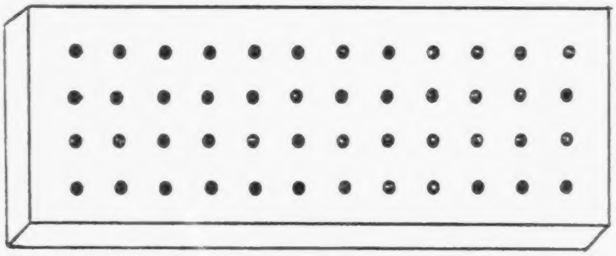
Mastermind for Young Children

Helen Thatcher

This version of a popular commercial game can be made inexpensively for the classroom from peg board and golf tees. The board should have 12 rows of 4 holes. You need 5 or 6 different colored tees, at least a dozen of each, and a board for each player. The board will look this way:



Make a little "table" of the board by placing a tee in the underside of each corner hole.

The game is valuable for children in helping them develop the strategy of problem solving by using information to eliminate alternatives. Children can start with a simplified adaptation of the game and proceed to more sophisticated versions as they become more skillful. They will invent new versions themselves.

In the beginning the teacher plays the game with one child, then another. Several usually want to observe, so that soon there is a little core of mastermind players. Here is one way to play:

One player places 3 different colored pegs on the end of the board nearest his body, hiding the row from the other player with a special piece of paper. The order of colors does not matter in the beginner's version. The second player "guesses" at the colors by placing 3 pegs near the end of his own board. The first player then "shows" the second player his correct guesses, placing the peg of the correct color or colors on the board so that the second player can see it. If there is none correct (this might happen in the case of 6 colors), the first player says, "You have none correct." The second player "guesses" again, making a new row next to the first row. The first player again shows the correct guesses by putting the same color pegs in his own board. This continues until player No. 2 has "guessed" all three pegs correctly. The last play of the course is no guess.

The game can be made more difficult by requiring the second player to deduce not only the right colors but the exact order of the original set, by using sets of 4 colors, by agreeing that a hole can be left blank, that a color can be used more than once, etc. Very young children can play with 2 colors. Some younger children may become skillful enough to play the game as originally conceived.

This game is a good vehicle for "child watching". Some children promptly use the information given to them. Some do random guessing. It is interesting to watch the random guessers develop a strategy as they become more experienced. Mastermind is a good game for children who are not having academic success. There is not a "winner". Everyone usually manages to "break the code".

Suggestion for the prudent. Have more than one set. It is possible for 2 players to use the same board if each plays on his own end of the board. Pegs should not be pulled out to use again since the information should always be available.

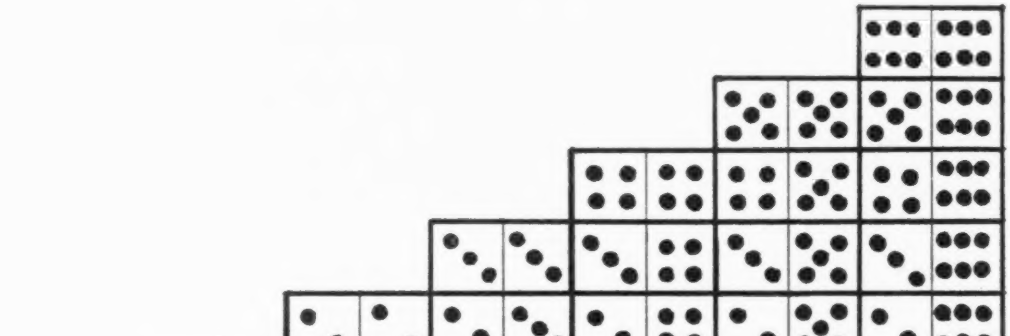
The Process Approach to Problem Solving - Some Observations

Alex Bakeeff

The experience described below provided this writer with some insight into the mathematical richness, the curriculum potential and the range of positive and negative feelings that can be experienced in using the process approach in solving a mathematical problem. This paper attempts to chronicle this experience and relate it to children in the classroom.

With a set of double-six dominoes spread out on the table, one was removed without our knowing which one. The task for each group of 3 to 5 people was to find its missing domino using this procedure: 1) make an endless train of dominoes, and, 2) in making the train, the number of spots on each end of a domino must match the number of spots on the end of the adjacent domino.

After a period of confusion, and lack of progress, we (Sally, Alex and Mary) decided to ignore directions and try to solve the problem in some other way. By systematically arranging the dominoes in a staircase, or histogram pattern (see fig. 1) the missing domino was easily identified.

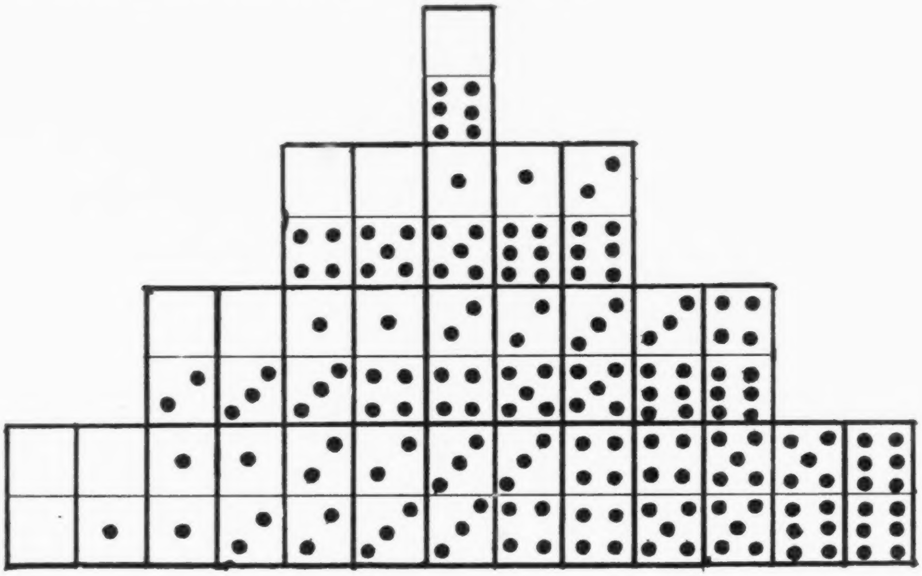


Although the missing domino had been identified, this was at best a qualified success.

The work of the class moved on to other situations without a loss of interest in solving the first problem within original restrictions. During the next two days the problem was attempted several times.

One the first occasion, the starting point was the staircase in Figure 1. On the second occasion the lack of getting anywhere led to temporarily by-passing the original problem. The detour centered on finding the sum of the spots in the double-six domino set. Using the staircase, one can easily count the total number of spots. A more interesting problem is to look for a pattern from which one can evolve an arithmetic expression that will produce this sum. A further extension is to generalize and look for a rule that will give the sum of spots for any size domino set.

During this detour, Jerzy pointed out another way to systematically organize the dominoes (see fig. 2). Based on this pattern he demonstrated a mathematical method for finding the sum of spots in each row.



In this method the dominoes are paired: first and last, third and third from last and so on. The sum of the spots for each pair turns out to be the same. Knowing the number of pairs one can easily find the total number of spots in each row. This method is generally credited to the "Prince of Mathematics", Carl Gauss (1777-1855). If more information about this method is desired, any history of mathematics should detail the method as well as the interesting story behind its development.

Seeing the application of this method to the problem at hand was like meeting an old friend from undergraduate days. At that time this method was taught to me academically, that is, outside real world experiences. Perhaps the memory of this method has remained all these years because the interesting origin of the method.

The other interesting aspect of this diversion came from seeing this arrangement of the dominoes (Figure 2) resemble a normal distribution or bell shaped curve.

Unfortunately this excursion added little to resolve the original problem or ease the mounting frustration.

During a subsequent return to the problem, the methods of organizing dominoes described above (Figures 1 and 2), suggested using ordered pairs as a means of recording these organizations. For Figure 2, the first element of an ordered pair was defined to represent the number of spots at the top of a domino. The second element represented the bottom spots. The distribution would then appear as:

Row 4: (0,6)
Row 3: (0,4),(0,5),(1,5),(1,6),(2,6)
Row 2: (0,2),(0,3),(1,3),(1,4),(2,4),(2,5),(3,5),(3,6),(4,6)

Row 1: (0,0),(0,1),(1,1),(1,2),(2,2),(2,3),(3,3),(3,4),
(4,4),(4,5),(5,5),(5,6),(6,6)

Though I enjoyed the feeling of satisfaction produced by putting together this bit of symbolism, it appeared to be of no help with the original problem. Thus this aspect of the problem was put aside and not pursued further.

Up to this point in this investigation, some interesting aspects had been uncovered. However, lack of progress on the original problem made its solution seem as remote as ever. This lack of progress was distressing. It was also embarrassing, knowing that others had easily succeeded. I began to question my ability to solve problems. At this point there was a temptation to withdraw from this problem and turn to something else.

On the third day after beginning this problem, the a-ha finally arrived. After re-creating the histogram and distribution for the nth time as a warm-up, a-ha said that the train must begin with the double-blank (0,0) domino. At that moment, this seemed like a big breakthrough. The use of the double-blank would permit building on to the train in two directions. Arriving at this conclusion produced great delight. In five minutes the train was completed and the missing domino identified.

Using ordered pair notation, the train is presented below in two parts- the right and the left end.

Right: (0,0),(0,1),(1,1),(1,2),(2,2),(2,0),(0,3),(3,3),(3,2),(2,4),(4,4),
(4,3),(3,1),(1,4),(4,0),(0,5)

Left: (1,6),(6,2),(2,5),(5,3),(3,6),(6,4),(4,5),(5,5),(5,6),(6,6),(6,0),
(0,0)

Now can you tell which domino was missing?

A further question arose: Is this arrangement unique? Some messing around quickly revealed that the underlined portion above could be replaced with (2,3),(3,3),(3,0),(0,2). Here was the seed(s) for other excursions: What are some other sequences that would work? How many are there? Could the train be started with one of the non-double-blanked dominoes?

Another possible excursion resulted from a conversation with Shirley in discussing this problem. Is an endless train possible with other domino sets? i.e. double-five, double-four, double-nine etc. This problem was quickly resolved but is left for the interested reader to consider.

After briefly wallowing in the satisfaction of being successful, other questions came to mind: Why did this problem appear to be so difficult? With the solution, and hindsight, the problem turned to a trivial exercise. Is this a characteristic of all problems? Was the problem incompletely perceived, thus requiring a longer incubation period? Did the extended length of time elapsing from the first statement of the problem to the moment of insight which led directly to a solution imply adoption of inefficient or ineffective strategies during the early stages of problem consideration? Was the incubation period longer than necessary because of insufficient discussion and sharing of ideas with others early on in the investigation? Do some people require a longer incubation period than others? Do other adults go through the same process and feelings as this adult experienced during this investigation? How does the internal problem solving process of children compare with the same process in adults? How vital is oral language to this process?

The writer does not have definitive answers to these questions. Some observations may be useful in establishing a direction or point of view.

This type of activity emphasizes process as distinct from content. As such it permits the investigator to make choices as to how to deal with the problem. Time constraints, strategies, creative input, and the selection of which spin-off problems to pursue are at the choice of the investigator. Choices arise almost continuously. They result solely from the interaction between the investigator and the problem situation. The injection of input by others not actively engaged in the process of solving the problem can be a hinderance, unless the investigator seeks specific information related to an aspect of the problem then under consideration.

The total absence of external pressure plays a significant role in leaving the investigator free to make the types of choices described above. Sometimes the path chosen is unproductive. This in itself is positive information since it indicates a direction that is not desired.

In the process approach, the investigator can build his/her own bridges out of one's experience and interaction with a situation and/or related materials. The learning that results is uniquely personal. It is learning that does not depend on the burdens and points of view of others. It belongs to (i.e. becomes a part of) the learner.

How does all this relate to the classroom? The value of including this type of experience in the school life of each child is confirmed by increasing numbers of researchers and teachers. Piaget has given a theoretical foundation to an old idea. Since World War II, schools in Great Britain have implemented this type of learning experience in countless schools. The practice is gradually being adopted in other countries.

The advantages to children of using a process approach are several. It permits dynamic learning to take place. Skill in problem solving (reasoning) is improved. It provides children (especially young children) with practice in oral language. (The use of oral language has been historically stifled in the traditional practices of schools. Now television acts to further limit a child's oral language experiences. This has to be a paradox since the basis of all other forms of language is oral language.) It can help develop skill in sharing and cooperating with others. Each problem can be a rich source of other problems waiting to be identified by the creativity of the children. Although the context of the missing dominoes problem was essentially mathematical, this method can be used in other subject areas. Finally, the success acts as an anti-toxin to the self-destruct nature of the negative feelings. They do not eliminate these negative feelings. They do provide children with the opportunity to control the solving process so that counter balancing positive feelings can be experienced. This control is almost totally missing in the static, content-oriented situations that currently make up the bulk of a child's school learning experiences.

There is much experience supporting the idea that children can build their own bridges and find new directions to follow through their own explorations. Teachers must set up these problem situations, permitting the child both freedom and opportunity to build these bridges. Neither teacher nor situation should overwhelm the child. Thus the attainment of the advantages of small group problem solving listed above depend on the teacher's carefully choosing his/her own attitude and behavior towards each child as well as the problem situations.

There seems to be sufficient school experience, research and a theoretical foundation supporting small group problem solving to conclude that this type of learning experience is not on educational fad. The reasons for using it have been established in practice and theory. To this writer, the primary obstacle to a significant spread of this type of activity is cultural. The process approach has not been experienced by the vast majority of teachers. Their own experiences as pupils, students, teacher trainees and their own practices in the classroom are based on a content approach, i.e., the teacher is the active element making choices and dispensing knowledge. Thus the challenge is to overcome this experience lag by helping teachers and student teachers feel comfortable with the process approach.

Dice, Dominoes, and Thinking

Mary Kay Pritchett

Dice and dominoes are very ordinary objects which we can find in many of our own homes. Ordinary though they are, they can be used in some very complicated thinking problems or for "hands on" activities in teaching children math.

These common articles have some properties which were unknown to me, even though I have used them most of my life; and these properties add other dimensions to their use as educational tools. Did you know that there are Double Six, Double Nine, and Double Twelve sets of dominoes? Do you know how many dots are found in a set of Double Six? What about Double Nine? Double Twelve? How can you find out the number of dots in each set? Did you know that each of these sets of dominoes will form a complete chain if you match the sides of the dominoes in the set as you do when playing the game? Can you think of a way to discover which domino is missing from the set by using this knowledge?

What about dice? What amazing things are there to know about them? What is the sum of any two opposite sides of a die? Look at one! If you pick up a die with your thumb and forefinger, covering the top and bottom of the die, the sum of the dots will always be seven no matter wich numbers you have covered. Pick up two dice, one on top of the other and holding them in the same manner as above. How many dots are hidden now? What if you hold three dice in this way? What about four dice?

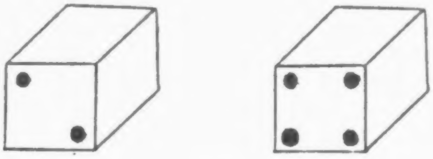
Using this information about dice, you can use these activities with your children:

Activity 1:

After working with the children so that they have discovered that the opposite sides of a die have the sum of seven, show them one side of the die and have them tell you how many dots are on the opposite side.

Activity 2:

Have the children roll the two dice, then let them tell the sum of the hidden sides. For example:



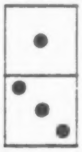
Solution: The sum of the hidden sides would be 8 because a five would be opposite the two and a three would be opposite the four and 5 + 3 = 8 OR the sum shown is six, and we know that the total sum of the opposite sides would be fourteen, so the hidden side must equal 8. Got it?

For more advanced players, three or four dice could be thrown, OR the children could give the product of the hidden sides.

Dominoes can also be used in teaching math.

Activity 3:

Dominoes can be used in working with fractions. For example:



can be expressed as one third. The child would then draw a picture to represent one third by shading one third of a circle, rectangle or some other object. If you have access to linking cubes, the fraction could be built by using different colored linking cubes.

A variation of this activity would be to classify the dominoes by putting the equivalent fractions together.

Activity 4:

Spread a set of dominoes (Double Six) on the table, face up. The children would take turns rolling two dice. The child would find the domino with numbers that match the numbers on the dice and take it. The play would continue until all dominoes were taken. The player with the most dominoes in the end is the winner.

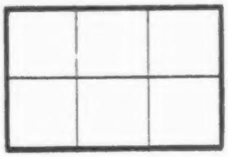
Variation: Take out any domino which has the same sum as the sum on the dice.

Variation: Use Double Nine dominoes and three dice. What about Double Twelve and four dice?

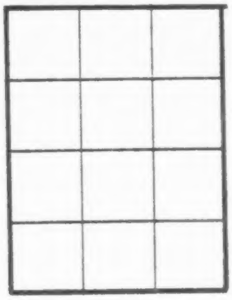
Find the Area

Jana Rotz Groninger

This shape has an area of one.



This shape has an area of two.

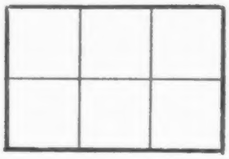


Draw for me a shape with area of three. Is there more than one possibility?

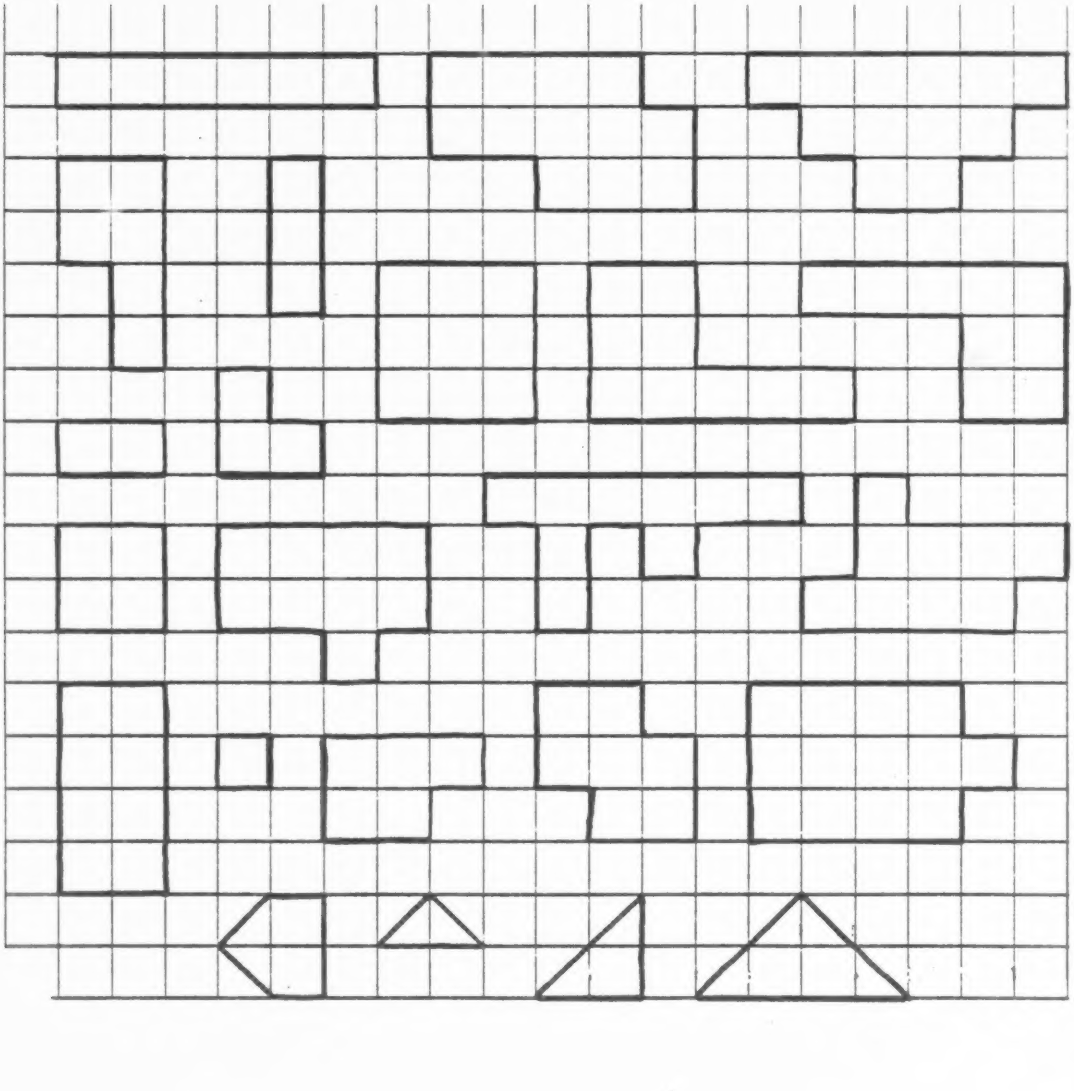
Draw as many different shapes as you can, having areas of one, two, or three.

Draw at least one shape for each of these areas: 2, 3, ½, 1½, 5/2, 1/3, 2/3, 3/3, 4/3, 2 2/3, 1/6, 2/6, 3/6, 4/6, 5/6, 6/6, 7/6, 1 5/6

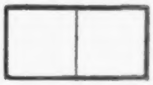
This shape has an area of one.



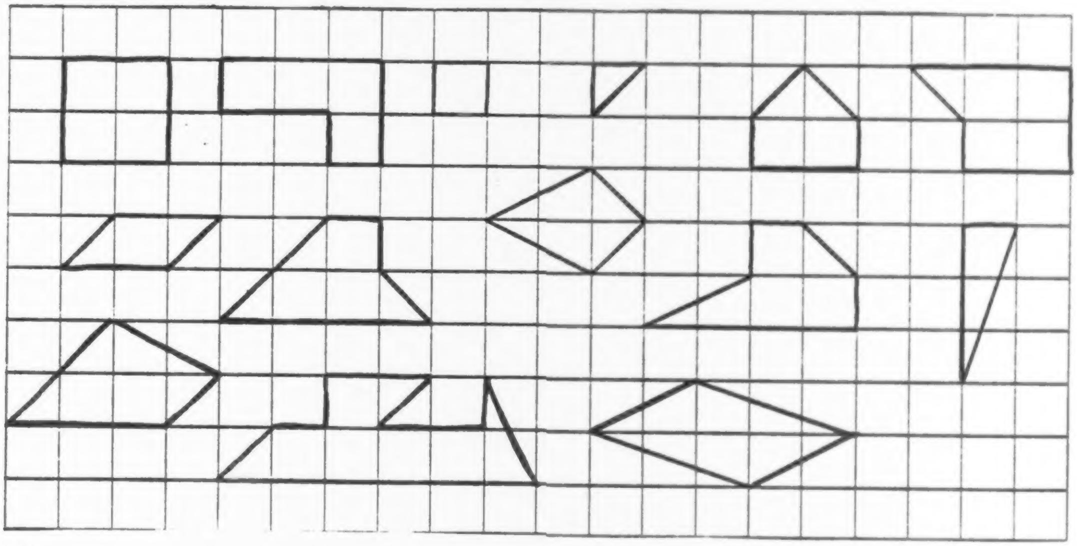
For each of the shapes drawn below write its area inside of it.



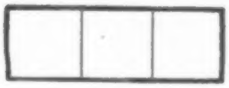
This shape has an area of one.



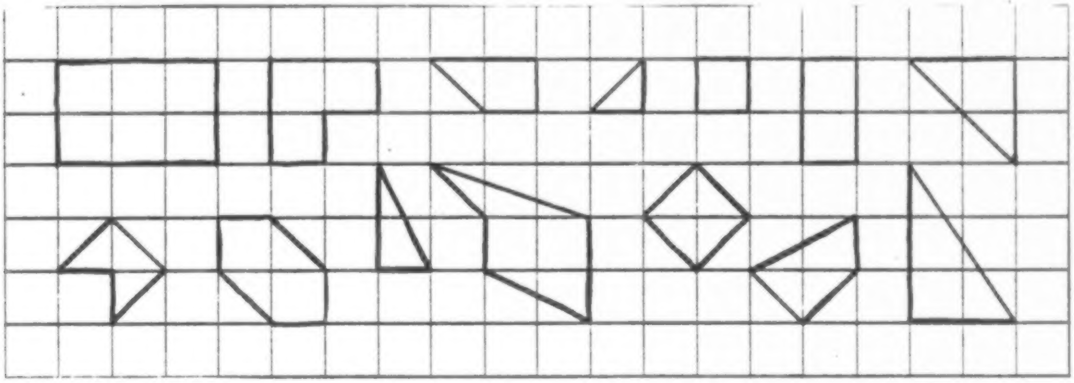
For each of these shapes write its area inside.



This shape has an area of two.



For each of these shapes, write its area inside.

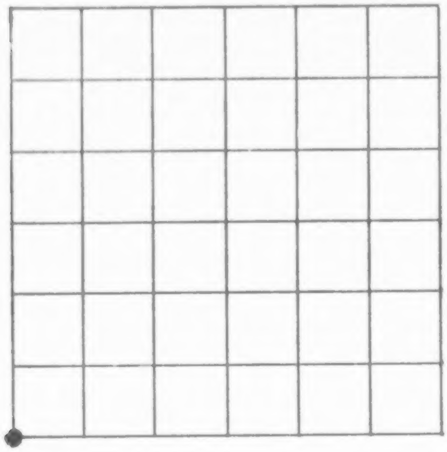


Make up some problems like these of your own.

Zork

Charlotte Wild

Once upon a time a planet named Zork was discovered. Beings from all planets met to decide who should have ownership. They decided fighting was not the answer. An American being happened to have a set of dominoes with him. They thought and thought and finally agreed on this playing board.



Before play begins all dominoes are turned face-down and mixed. The playing board is squared paper. Play begins in one corner.

The first player chooses a domino. The domino has two parts, each containing a set of spots. He uses the number of dots on one end of his domino to determine how many spaces to move to the right (⟶) and the number of spots on the other end to determine how many spaces to move up (↑). When that position is located, the player puts his symbol there.

The succeeding players do the same thing. The winner of the game is the person who is the first to get four of his symbols in a row (horizontally, vertically or diagonally).

Try it! What decisions need to be made? Play for other planets.

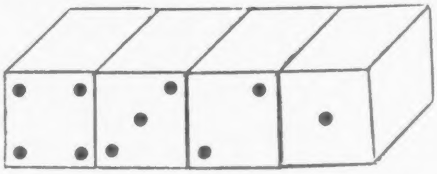
Make A Caterpillar

Marjorie Elliott

In helping children to think, it is necessary that we encourage the process by asking appropriate questions. Our activities need to be of a progressive nature so that they increase in difficulty allowing for the children who are at different stages in the thinking process. The following game demonstrates this process. It is devised for kindergarten children. I have made up some rules, but it is fun to let the children devise their own rules as they go.

Task: Make a caterpillar of 4 dice.

Rule: Arrange him so that the dots on his side go from 1 to 4 in sequence.



Questions: Can you rearrange the caterpillar so that the 1 is on the other end?

How many dice would be necessary to use so that all of the dot patterns (1-6) would show on one side?

What will the other side of your dice look like?

How many parts would your caterpillar have if you arranged your dots by twos, by threes?

This part of the game allows the children to work with number concepts. For those who are able to go on with 2 concepts, color can be added.

Task: Make a caterpillar using dice of 2 different colors.

Rule: The numbers should be in sequence with the colors alternating. Use numbers 1-6.

Questions: How many of each color would it take to make your caterpillar with the numbers 1-6?

New Rule: Arrange dice so that there are 2 of 1 color, 1 of another using numbers 1-6.

Questions: How many different combinations can you make?

How many dice will it take for each combination?

How many combinations can you make using 3 colors?

How many dice are required for each combination?

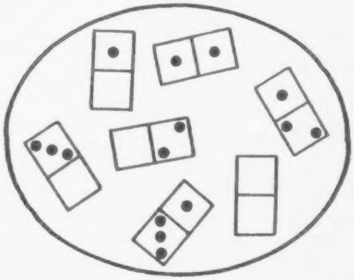
Question for the teacher: Can you devise games with dice for your children that challenge their thinking?

Seedling Transplants From Poland

The following problems, developed by Jerzy Cwirko-Godycki, were used at the Eighth Annual Summer Course of the Teachers' Center Project, August 1979. A full set of Dr. Cwirko's problems are soon to be available from the Teachers' Center Project. Problems such as these gave rise to course participants' work as it appears in this SEEDBED.

1

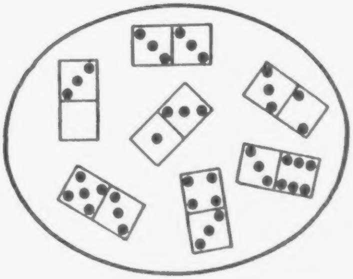
DOMINOES IN THE LOOPS



In this loop the sum of spots is 15

○ What is the minimum and maximum number of dominoes when the sum of spots in the loop is 15?

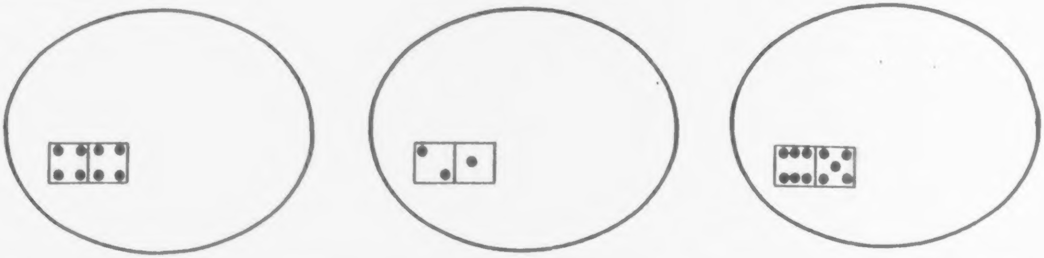
○ Find the answer when there are other numbers of spots in the loop.



What rule have we used to arrange the dominoes in the loop and what is the sum of spots in this loop ?

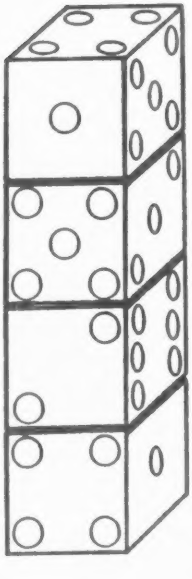
○ What dominoes can you put into these loops using a similar rule ?

○ Is there only one way to do it ?

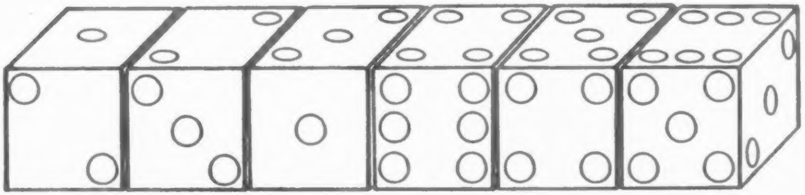


BUILDINGS

6



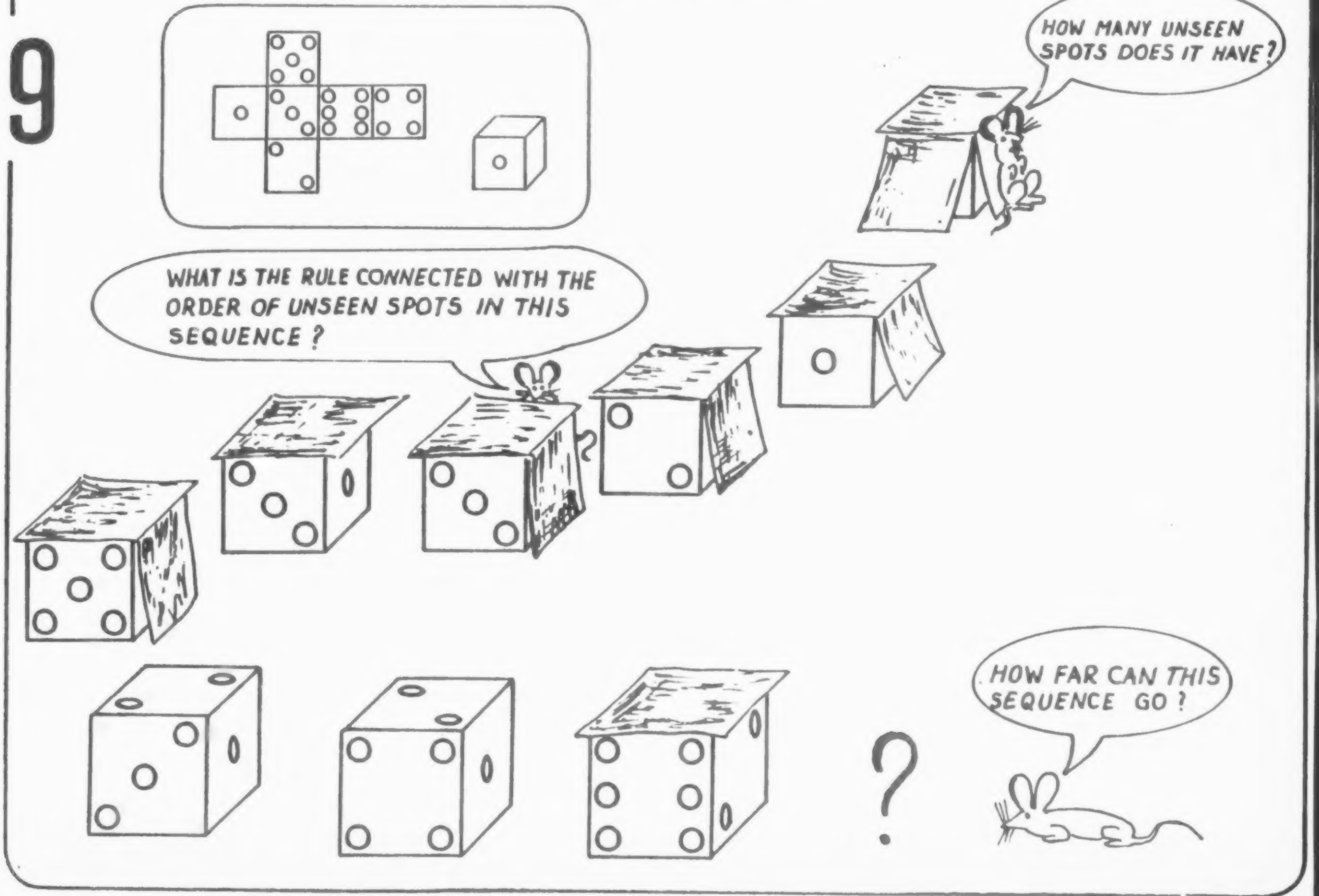
What is the sum of all the spots on the horizontal unseen faces?



How many spots are there on the bottom of this wall?

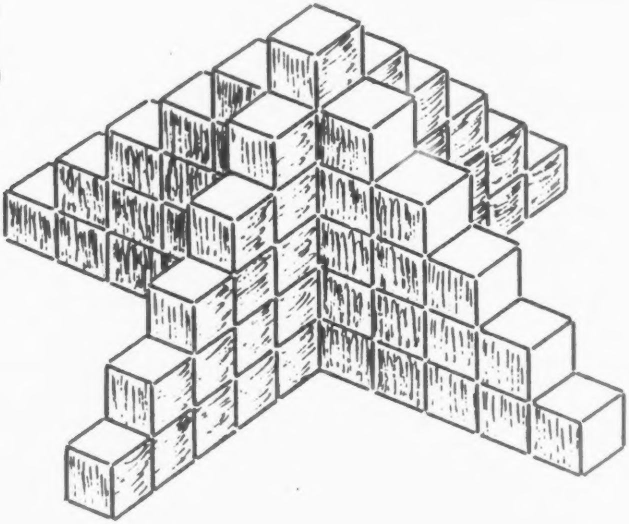
9

THE DICE SEQUENCE


HOW MANY UNSEEN SPOTS DOES IT HAVE?
WHAT IS THE RULE CONNECTED WITH THE ORDER OF UNSEEN SPOTS IN THIS SEQUENCE?
?
HOW FAR CAN THIS SEQUENCE GO?

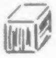
TV - TOWER

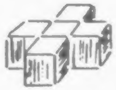
14

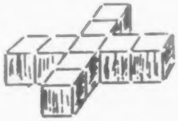


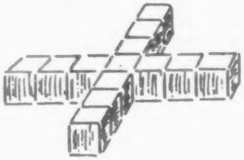
How many cubes do you need to build this tower ?

HOW MANY CUBES HAS THE GROUND - FLOOR WHEN THE TOWER HAS 6, 7, ... 10, ... FLOORS ?



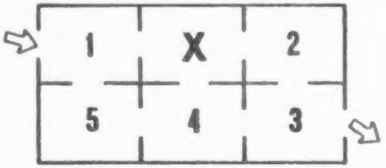


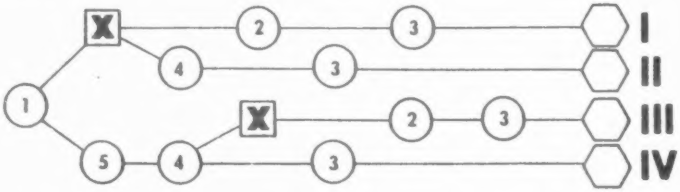




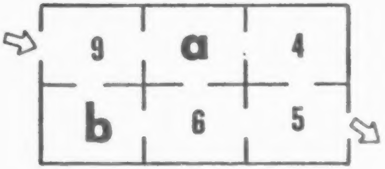
MAZE WITH X

23

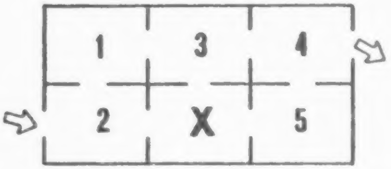



X
2
3
I
4
3
II
1
X
2
3
III
5
4
3
IV

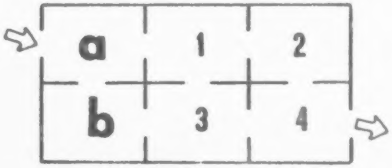
What is the value of X if the sum of numbers is the same for paths I and IV ?



What should be the values of a and b to obtain a minimum of 20 and a maximum of 33 ?



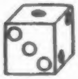
What should be the value of X to obtain a maximum of 15 and a minimum of 9 !

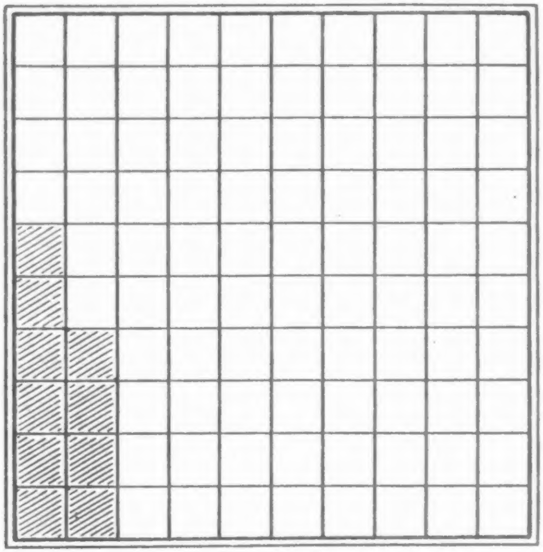


What should be the values of a and b to obtain a minimum of 12 and a maximum of 15 ?

PAINT THE SQUARE

33





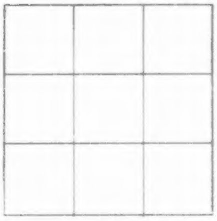
1. Each player has a 10×10 grid
2. Players throw a die in turn
3. The die tells you the number of squares you may colour in any column
4. You may not split your colouring allowance between columns. In the illustration a throw of ⚄ cannot be used to part fill the first column
5. The first who colour the whole grid is the winner

What is the best strategy to paint the whole square?

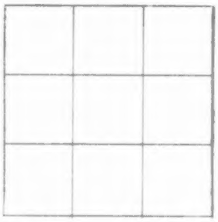
Magic Squares

Mary Kay Pritchett

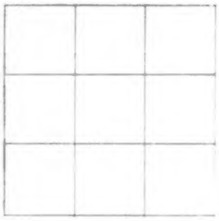
To solve a magic square you must place 9 numbers in the square so that the sums of the columns, rows and diagonals are all the same number.



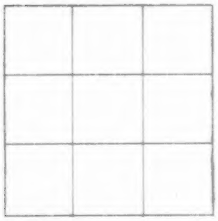
Use numbers
1-9 to make
a sum of 15



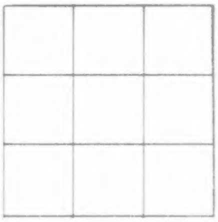
Use numbers
2-10 to make
a sum of 18



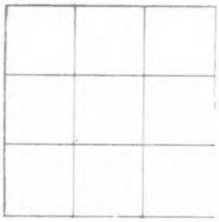
Use numbers
6-14 to make
a sum of 30.



Use numbers
3-11 to make
a sum of 21



Use numbers
5-13 to make
a sum of 27



Use numbers
4-12 to make
a sum of 24

Now that you have completed the squares, can you see any pattern to follow as the the solutions? How can you discover which number should go in the center square? Is there any logical way to go about solving these squares?

Will the same strategy work with a 5 x 5 square with a sum of 65 using numbers 1-25?

Using Double-Six Dominoes

Edna Greer

Using one set of double six dominoes fill in the puzzle below.

15	8		24
	14		24
	5	13	24
12			24
		9	24
40	40	40	

The dominoes may be stacked in each block (if necessary) to get the number needed in each block. The numbers must add up to 24 horizontally and 40 vertically.

(Example -- the 10 and 5 dominoes may be stacked to get 15.)

What if:

1) more than one set of double six dominoes was used?
2) one set of double nine dominoes was used? more than one set?
3) one set of double twelves was used? more than one set?

Special Children

Charlotte Wild

Who is the special child? When you really look at any child, you see that each is special in his or her own way. Visitors to our class were asked to select the special children. Guess what? They were wrong. There seems to be a reluctance to include these children in regular classrooms, yet it can be done successfully. Obviusly, this paper can't deal with all the implications. Since we have been dealing with the intellectual growth of children, it seems appropriate to examine this aspect.

Four years ago, I was fortunate enough to begin looking at what and how I was teaching. I became involved in a number of workshops which helped me develop some techniques to help children learn in math. Gradually my program has become more discovery approach using concrete aids. I was really pleased with the children's progress.

Then, last year, I had a "special" child in my math program. I had to do nothing extra for this girl. Other children often helped her as they as they do each other. She had a real desire to attain and worked hard so that she progressed more than some other children.

In talking with her teacher, I shared some of the activities we were doing. She decided to try them in her class and was surprised how much her class enjoyed the activities.

Children all come to us with a wide variety of experiences. The special child is no different. We as teachers can accept the challenge. All children go through the learning process at different speeds.

I would like to close with this quote: "Children are not wrong; they merely respond to the stimulus according to their knowledge and development at the particular time we are checking their progress. If teachers keep this in mind, they will give every child the encouragement he requires to gain confidence in his own abilities and to realize his maximum potential."[1] This is a beautiful goal.

---

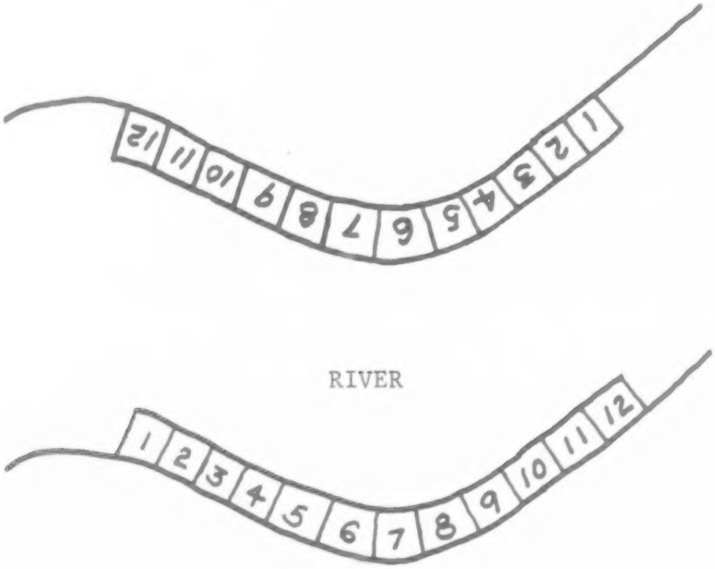
[1] Biggs, Edith and MacLean, James Freedom to Learn, Addison Wesley, Reading, MA, 1969.

Probability

Annemarie Garcia

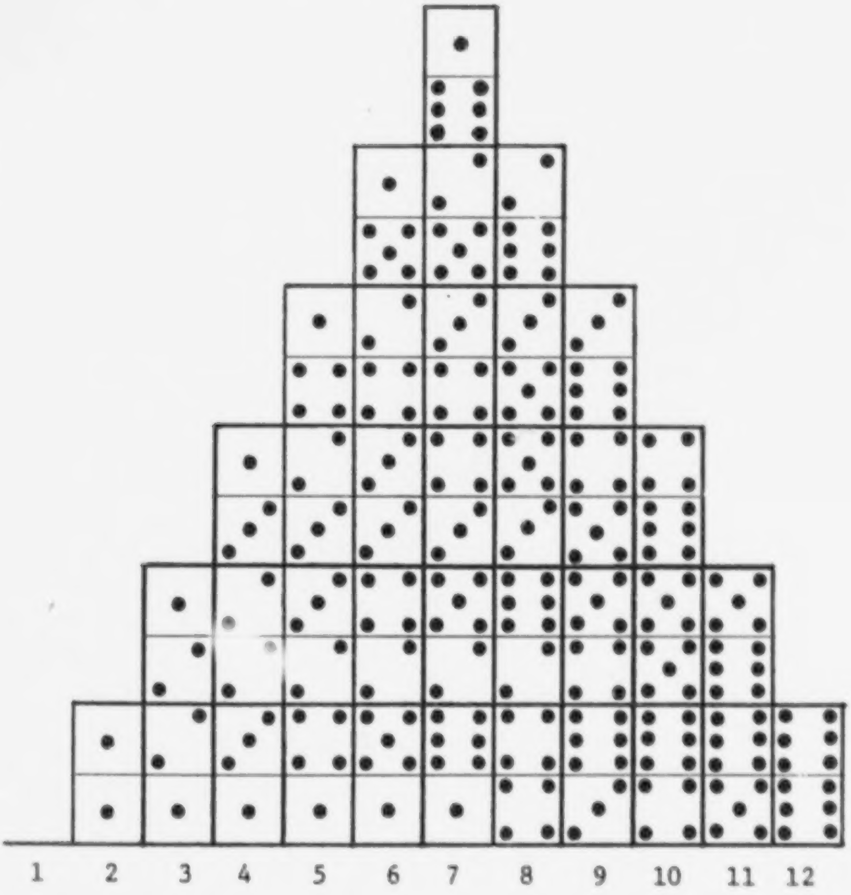
This activity was created after playing a game designed by Jerzy Cwirko-Godycki of Poland. His game "River Crossing" goes as follows:

Two players start the game; each of them has 12 markers and 12 possible starting points (numbered 1-12) on his side of the river. He may distribute the markers on the starting positions any way he chooses (all on one number, one on each number, etc.). The players throw 2 dice by turns. The sum of the number of spots on the dice shows the number of starting point from which one marker crosses the river. The player whose team crosses the river first is the winner.



From this arises the question, what numbers have the greatest probability of appearing on the two dice? Students could find the answer to that question by constructing a graph of all the possible combinations of 1, 2, 3, ..., 12 using a double-six set of dominoes as reference. Is it possible to get a 1 on a pair of dice? How many ways can a player get a 2 on a pair of dice? After going through the possible combinations of the numbers 1-12, a graph can be constructed using dominoes.

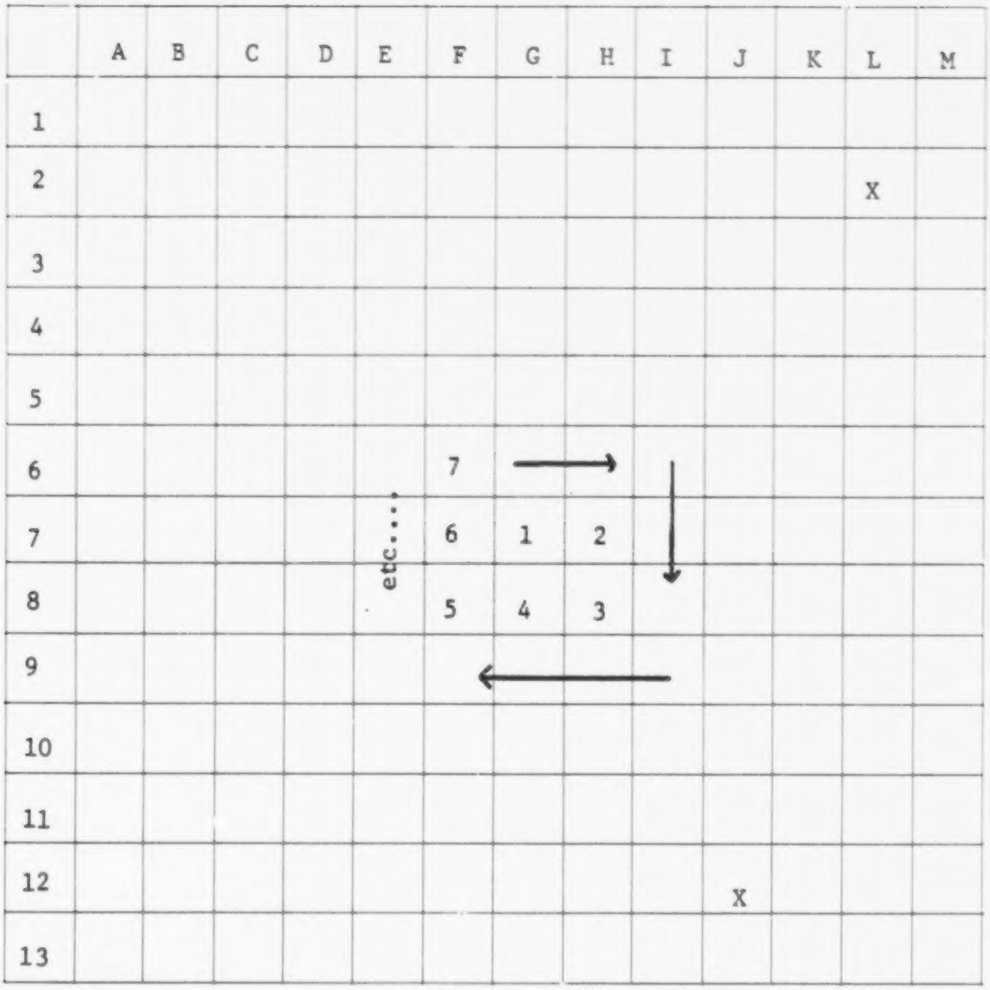
Graph:



From this graph students could see that the number 7 has the greatest probability of appearing on a pair of dice. New questions arise. Would a person have a better chance of winning is he puts all 12 markers on the 7? Is there a better way of arranging the markers on the river? Is there a best way? An extension problem could be, if the river was numbered 1-16 and the game was played with octagonal dice, eight-sides, numbered 1-8, what number then has the greatest probability of appearing? the next greatest? the least?

Spiral Square

Eugene W. Daily



	A	B	C	D	E	F	G	H	I	J	K	L	M
1													
2												X	
3													
4													
5													
6						7	→						
7					etc....	6	1	2	↓				
8						5	4	3					
9								←					
10													
11													
12										X			
13													

Without completing the spiral, tell the number of 2-L.

What is the number of 12-J?

Can you make other spirals and chart numbers on them?

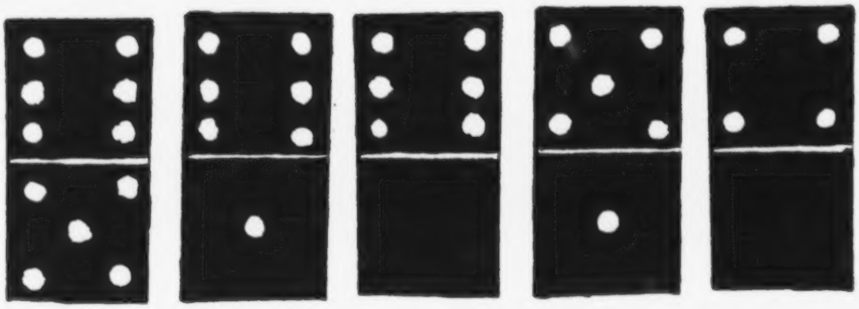
Math Game

Rosemary Wyche

Number of players: Class or team game

Materials: Dominoes (double-six or double-nine), pencil and paper

Directions: Someone (or several people) pick 5 dominoes which are to be used along with the operations +, -, x, ÷, in that order to arrive at the largest number. The sum of the spots on the die is the number for that die. Students are to determine the best order of the numbers relative to size that would give the largest number.



Suppose the above dominoes are picked. The numbers to be used are 11, 7, 6, 6, 4.

11 + 7 - 6 x 6 ÷ 4 = 18

11 + 6 - 7 x 6 ÷ 4 = 15

11 + 4 - 7 x 6 ÷ 6 = 8

7 + 6 - 4 x 11 ÷ 6 = 16.5

7 + 6 - 6 x 11 ÷ 4 = 19.25

Will the last arrangement give the largest number?

Variations:

a) Determine the smallest positive number using the same directions.

b) Introduce parentheses and repeat general directions and variations (from a).

c) Pick a target number, say 47, and obtain it using all five numbers and any combination of +, -, x, or ÷ .

Cubes Are Contagious

Jean Kelleher

There are many ways to put together cubes. If you wish to make constructions with them, a few extra flaps promote sturdiness. Construction paper or any heavy weight paper is better than ditto paper.

Start with a square (a 9" x 9" square will form a 2½" x 4½" x 2½" rectangular prism or a 2½" cube). Children can experiment with various sized squares for smaller or larger cubes.

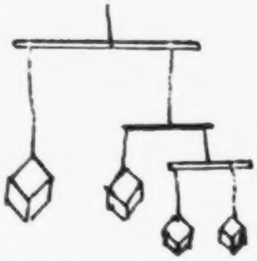
Use cubes for

building

mobiles

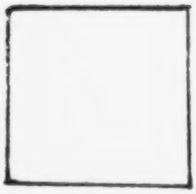
solving problems

?????

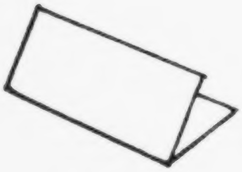


To fold a cube, start with a square

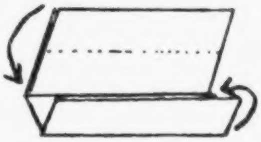
(1)



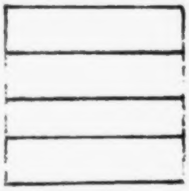
(2) Fold in half



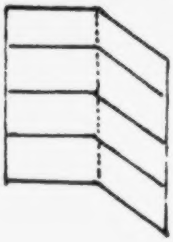
(3) Open and fold ends toward middle fold



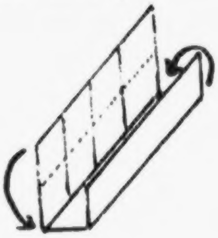
(4) Paper will lool like this when open (3 folds, 4 sections)



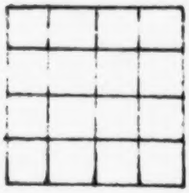
(5) Fold paper in half in the opposite direction in the opposite



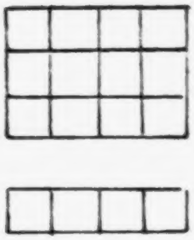
(6) Open and fold ends toward middle (as in #3)



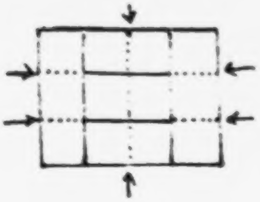
(7) Paper will look like this when open (16 squares)



(8) For a cube, cut off one row of squares



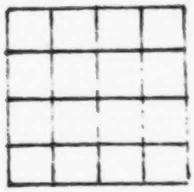
(9) Make 6 cuts (arrows and dotted lines show where). Each cut is one square long.



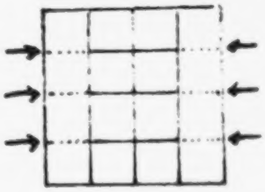
(10) Fold and glue flaps to make cube.

To form a rectangular prism, fold paper the same as for a cube.

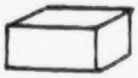
(1)



(2) Make 6 cuts (arrows and dotted lines show where). Each cut is one square long.



(3) Fold and glue flaps for prism

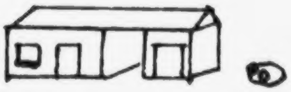


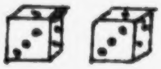
Activities:

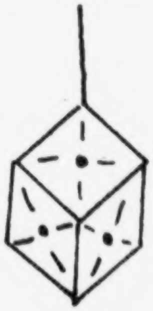
Let students find a "pet" rock and construct a house for it.

Make dice.

Place the end on a string in the last fold of a cube so it hangs from a point. Decorate with designs.







Dominoes, Dice and Strategy

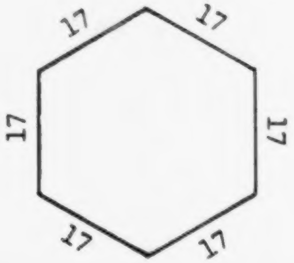
Peggy Tribout

This week I and about 29 other educators have been involved in a unique learning situation. We have been bombarded with dominoes, dice, linking cubes, tangrams, shapes, numbers, thought problems, etc. We have been challenged not only to solve problems, but also to be aware of HOW we solved the problem. Did we arrive at the solution randomly or was there a "method to our madness?" What steps did we follow to reach our goal? As educators, it's important that we know our own thought processes, so that we can recognize them in our students.

The following are some adding and subtracting activities using dominoes and dice. As you do them, or watch your students doing them, observe: Was the solution arrived at by chance or was there a definite strategy?

Dominoes I:

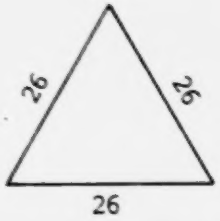
1) Take the set of dominoes that has the sums of 3, 4, 5, 6, 7, and 8. Arrange them in a 6-sided figure, so that all sides equal 17. The dots will total 102. Why?



2) Now try it so that touching corners must have matching dots.

Dominoes II:

Take the set of dominoes, but leave out all the doubles. Try to form an equilateral triangle. The sum of the dots on each of the 3 sides must equal 26. Why?



Extra challenge: Would it be possible to match dots around the entire triangle e.g. 6 to 6, 5 to 5, 0 to 0, etc?

Dice:

1) Take 8 dice. Place them together to make 2 x 2 x 2 cube such that the difference between all the touching faces is 3.

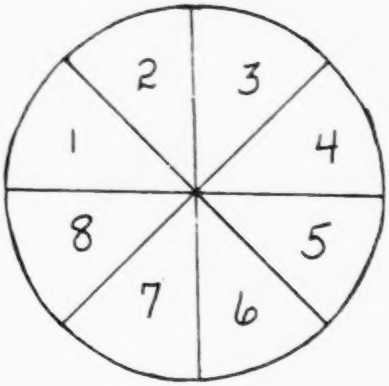
2) What is the sum of the hidden faces?

$A = \pi r^2$

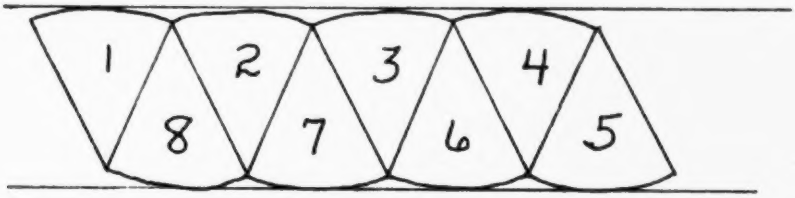
Edna Beckett

Many students find it difficult to understand the reasoning behind the formula $A = \pi r^2$. The astronomer Kepler is given credit for the idea which is the basis for the approach used here.

1. Each student is given a sheet of cardstock (medium weight) paper on which there are two parallel lines, and a circle divided into eight congruent sectors. The distance between the parallel lines equals the radius of the given circle.



2. Cut out the sectors and rearrange them between the parallel lines as pictured:



What polygons do the individual sectors resemble?

What is the "height" of the sector?

What is the "base" of the sector (based on the circle)?

What polvgon does the rearranged sectors resemble?

3. Give the students a circle which has been divided into twelve congruent sectors. Cut the sectors out and rearrange them as before. Place them on top of the other "parallelogram". Which of the two figures is more like a parallelogram? If the number of sectors were increased, how would the figures compare to the parallelogram?

4. What part of the circumference of the circles form the bases of the parallelograms? Write this in terms of the radius of the circle.

   ($C = \pi d$; $C = 2\pi r$; therefore, $\frac{1}{2}C = \pi r$.)

5. Apply the formula for the area of a parallelogram to the new figures:

   The base is one-half the circumference of the circle (πr)

   The altitude is the same as the altitude of the sectors, which is the radius of the circle (r).

   Therefore, $A = r(\pi r) = \pi r^2$.

Geographical Analogies

Marian Rhude

My fourth grade class had really gotten excited about geographical concepts, and one day they began to see relationships between some of the concepts (an "aha" time). The class started calling them out and I recorded them. At the time, they didn't know the term analogies, but I was excited to see evidence that their thinking had moved from level 1 (knowledge) to application (level 3) and on to synthesis (level 5) of Bloom's taxonomy.

Perhaps your class might like to figure out what the relationships are in these analogies. You might also leave blanks in the chart where I have words in parentheses, and let your class fill them in.

1.	gulfs (bays)	land	peninsulas	water
2.	strait	(land)	isthmus	(water)
3.	island	(water)	(lake)	land
4.	cities	counties	(states)	countries
5.	seas	oceans	(ponds)	lakes
6.	mountains	(valleys)	islands	ocean trenches
7.	bridges	water	(canals)	land
8.	archipelago	islands	tributaries (systems)	rivers

METRIC EDUCATION

(Swiped from the bulletin board of George Barhorst's classroom, John Burroughs School, St. Louis)

10^6 phones .... 1 megaphone

10^{-6} phones .... 1 microphone

10^{10} los .... 10 gigalos

10^{12} bulls .... 1 terabull

10^{-1} mates .... 1 decimate

10^{-2} pedes .... 1 centipede

10^{-9} nannattes .... 1 nanonannette

10^{-12} boos .... 1 picaboo

10^{-18} boys .... 1 attoboy

2×10^2 withits ...... 2 hectowithits

2×10^3 mockingbirds .. 2 kilomockingbirds

****

DEFINITIONS IN SCIENCE

(Swiped from the same place.)

If it's green or it wiggles .... it's biology.

If it stinks .... it's chemistry.

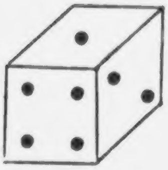
If it doesn't work .... it's physics.

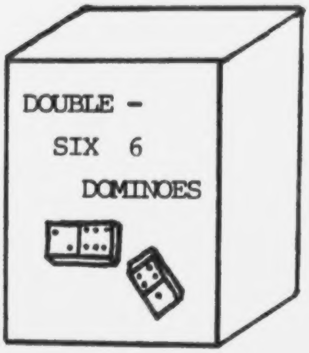
If it has parentheses .... it's mathematics.

Domino - Dice Game

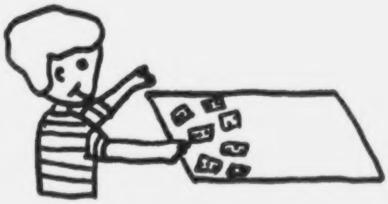
Pat Zahn

Materials: 1 die, a set of Double Six Dominoes, four players

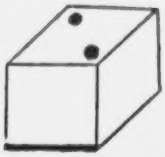




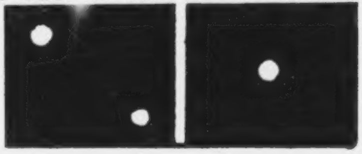
Each player draws seven dominoes and arranges then so only s/he can see them.



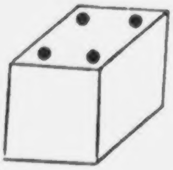
One child tosses the die.



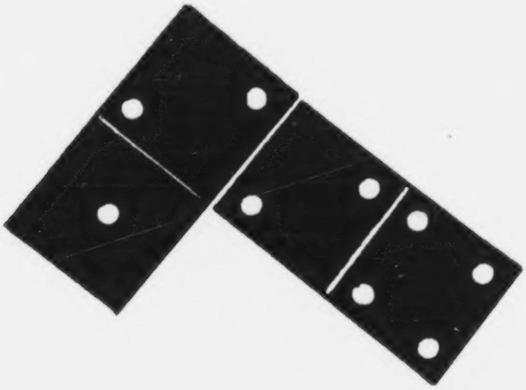
That child puts out one of his dominoes that contains that number.



The next player rolls the die.



He must then choose one of his dominoes that number and also forms a chain with the previous domino put down.



Play continues around the table.

If the child does not have a domino that contains the number he rolled and will continue the chain he loses his turn.

First player out of dominoes is the winner.

Excerpt from J. Bronowski, The Ascent of Man

Helen Thatcher

What Bronowski says here has been said before, but never more beautifully.

"We have to understand that the world can only be grasped by action, not by contemplation. The hand is more important than the eye.----- We are active; and indeed we know, as something more than a symbolic accident in the evolution of man, that it is the hand that drives the subsequent evolution of the brain.

"I have described the hand when it uses a tool as an instrument of discovery. We see this every time a child learns to couple hand and tool together--to lace its shoes, to thread a needle, to fly a kite or play a penny whistle. With the practical action there goes another, namely finding pleasure in the action for its own sake--in the skill that one perfects, and perfects by being pleased with it. This at bottom is responsible for every work of art, and science too: our poetic delight in what human beings can do because they can do it. The most exciting thing about that is that the poetic use in the end has the truly profound results. Even in pre-history man made tools that have an edge finer than they need have. The finer edge in its turn gave the tool a finer use, a practical refinement and extension to processes for which the tool had not been designed.

----"The hand is the cutting edge of the mind. Civilization is not a collection of finished artifacts, it is the elaboration of processes. In the end, the march of man is the refinement of the hand in action."

What Bronowski says here, if taken seriously and applied to education, could change what we do with children in the classroom, so that they could become a participant in and not just an observer of the "Ascent of Man".

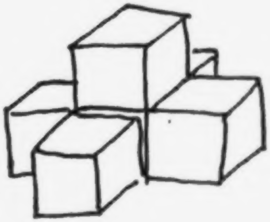
Bronowski, J., The Ascent of Man, Little, Brown, and Company, Waltham, MA, 1974.

Seedling Transplants From England

The following problems, developed by Jan Stanfield, were used at the Eighth Annual Summer Course of the Teachers' Center Project, August 1979. Problems such as these gave rise to course participants' work as it appears in this SEEDBED.

DICE 3

TAKE 6 DICE AND BUILD A PYRAMID.



NOW WITHOUT TOUCHING THE DICE, FIGURE OUT THE TOTAL OF UNSEEN SPOTS.

IS THIS TASK, AS THE SCOTS WOULD SAY, BEYOND HUMAN KEN?

USE DOUBLE SIDED TAPE TO MAKE PUZZLES OF THIS KIND. HOW COULD THEY BE USED IN CLASS?

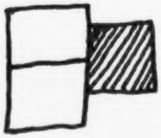
DICE 7

YOU HAVE ONE RED DIE AND LOTS OF WHITE ONES.

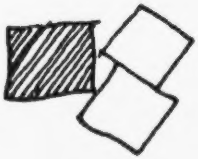
WHAT IS THE LARGEST NUMBER OF WHITE CUBES WHICH CAN TOUCH THE RED DIE?

'TOUCHING' MEANS THAT AT LEAST PART OF THE FACES ARE PRESSED TOGETHER.

YES:



NO:

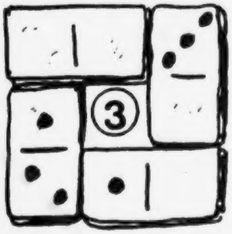


DOMINOES 1

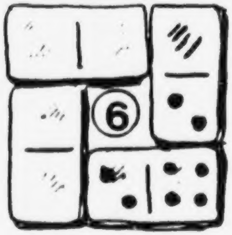
USING THE 28 PIECE SET OF DOMINOES, BUILD THE WIDEST ARCH POSSIBLE. MEASURE THE WIDTH AT THE BASE AND PUBLISH IT ON YOUR BOARD. THE WINNER GETS THE DOMINO ENGINEER OF THE YEAR AWARD.

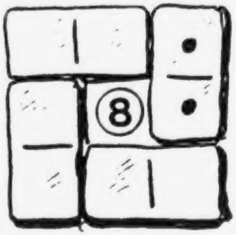
P. S. NO GLUE, TAPES, NAILS OR LEAD COUNTERWEIGHTS TO BE USED.

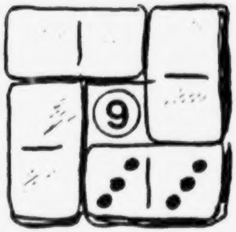
DOMINOES 7

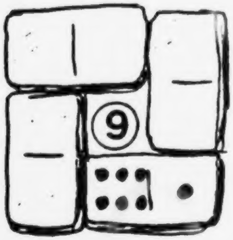


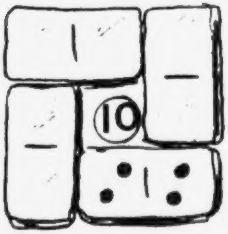
This one is completed

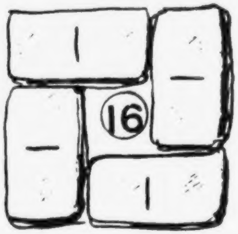












THE 28 DOMINOES HAVE BEEN ARRANGED IN 7 SQUARES. THE SIDE OF EVERY SQUARE ADDS UP TO THE NUMBER SHOWN IN THE CIRCLE. FIND THE OTHER DOMINOES. AT FIRST GLANCE, THIS IS A TEDIOUS PROBLEM, ON SECOND IT APPEARS EVEN DREARIER, BUT ON THIRD.......?

Tic Tac Toe with a Twist

Kay Haas

One of the oldest and first games children learn is tic tac toe. The game involves trying to achieve a goal - - - getting three in a row either vertically, horizontally or diagonally while keeping the opponent from doing the same.

A slight variation of the game could involve the use of dice and numbers instead of the traditional x's and o's.

Two players would play the game using one die, filling in numbers on the grid. The object of the game is to achieve a certain total using three numbers in a row either vertically, horizontally or diagonally. The total would be decided by both players before beginning play. In this case, we will arbitrarily use 12 as our total.

Let's go through a hypothetical game. Player 1 shakes and gets a 4 and places it randomly on the grid. Player 2 then gets a 3 (We will use broken lines for Player 2's numbers on the grid.) See Figure 1.

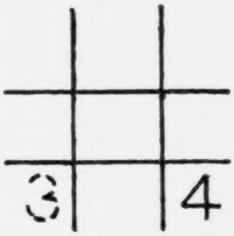


Figure 1

The moves will go as follows and can be followed in Figure 2.

Player 1 - 5

Player 2 - 2

Player 1 - 1

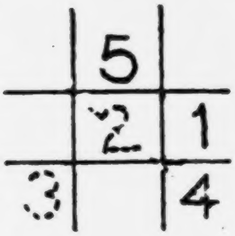


Figure 2

(You will notice that it is impossible by this time to get 12 vertically in column 3 and horizontally in row 2 or on the diagonal) Now this:

Player 2 - 6

Player 2 puts the 6 in the top left corner and wins the game.

Both players may use any numbers on the grid - not just the numbers they have rolled.

One more game:

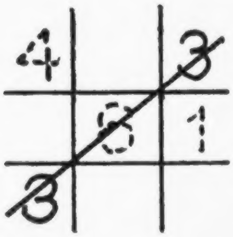
Player 1 - 6

Player 2 - 4

Player 1 - 3

Player 2 - 1, so far no rows
or columns

Player 1 - 3



Player 1 is the winner!

The blocking strategy of tic tac toe is not quite so evident because players can hurt their own chances to win by making rows impossible. It may even be possible to have no winner if too many rows become impossible.

Players can decide after several games if different goal totals, rather than 12, make more interesting games.

Since the game involves computation skills, older children may want to use two or three dice. Players may even decide to use the difference of the dice rather than the sum.

One more variation on the game would be to use dominoes instead of dice.

Excerpted from "Schools and the Growing Mind"

Louise Marks

One important insight which developmental teachers have gained is that nothing, really, is ever taught, not even by the best of teachers, if "teaching" is meant to be the transmitting of meaning, unchanged, from one mind to another. What seems to be successful teaching is the sharing of ideas for which the learner already has mental structures of understandings into which the shared ideas can be built. Making meaning, therefore, is an active process on the part of the learner of organizing the understandings within the mind. When the needed and relevant mental structures within the learner are not available, learning cannot occur. The task of the teacher is to provide learning opportunities which make possible the gradual building within the learner of the structure of understandings on which new learnings can develop.

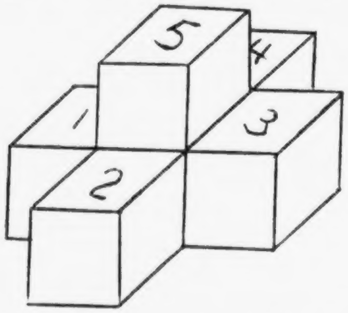
This is not always an easy task, for it often involves re-structuring for the learner of what is already known, the re-arrangement of current understandings so that the new reorganization of meaning can occur. It is these moments during the learning episode which are the most difficult, and when the learner is most vulnerable. At this juncture, the learner experiences confusion, contradiction, not-knowing, disequillibrium.

The full article is available from the author.

Hidden Dots

Annemarie Garcia

Arrange 6 dice in the arrangement:



Note: Die 6 is completely hidden on the sides by die 1,2,3, and 4 and on top by die 5.

What is the minimum number of dots which can be hidden with the six dice? Hidden dots are dots which can not be seen from the top and the side views on each die of the arrangement. What is the maximum number of dots which can be hidden with the six dice?

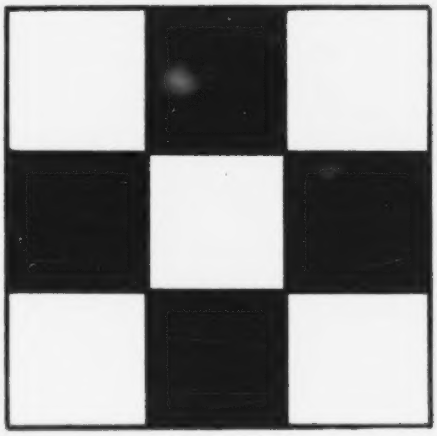
Is it possible to hide all the dots of all the numbers between the minimum and maximum?

Cubes

Marian Rhude

Using linking cubes of light and dark blocks, how many smaller cubes would you need to form this pattern on all 6 sides of the larger cube (which is solid)?

How many darker cubes would you need?



What other patterns could you arrange so that all 6 sides of the larger cube are alike?

Draw a diagram of your pattern.

How to Make a Million

JoAnne Stanko

Can you think of a way to make a million? It can be a million of anything. Here are some examples of how to make a million that my sixth grade students came up with when posed with that question:

1. Some students calculated how long you would have to live to be 1,000,000 seconds, 1,000,000 minutes, or 1,000,000 hours in age. Others wanted to know if the average sixth grader (11 years) had lived 1,000,000 days, hours, minutes, or seconds. Do you know the answers to these questions?

2. Another student figured out that 1,000,000 mm was 1 km. He marked out a route and we went for 1,000,000 mm hike.

3. The mm hike then prompted metric ideas, such as 1,000,000 square mm, or in simplest form, 1 square meter.

4. Two boys worked for days "counting" 1,000,000 grains of salt. Their final procedure, after much trial and error, was as follows: First they used a balance scale to weigh .5 g of salt. This was then carefully counted, using a black paper background and tweezers. They divided the result into one million and then weighed out the proper amount. What size container do you think it took?

5. Another boy chose to collect 1,000,000 drops of water. Again it took much trial and error before deciding on the following method. He first filled a straw with water. Putting his finger over the top end, he let one drop fall into a measuring cup at a time. He multiplied the number of drops needed to fill the straw by the number of times he had to empty the straw to fill the cup and then divided that into a million. How much water do you think it was?

6. Two girls who had access to a computer, printed out a million dots. They first had the computer print out my name, Mrs. Stanko. Next, they counted the number of dots in my name. This was divided into a million, and then the computer was told to print Mrs. Stanko the appropriate number of times. Do you have any idea how many times this was?

7. Another girl used a typewriter, typing paper, and carbon paper to make a million letters. How many pages do you think this would fill?

8. One of the most surprising projects involved trying to write 1,000,000 x's on graph paper. First, a boy figured out how many x's it would take to completely fill out one piece of graph paper. Then this was divided into 1,000,000 to determine how many pages were needed. Because it took so many pages the boy decided to have all of his classmates help him. They all got off to a great start, but I really expected them to tire quickly of filling the graph paper with x's. Instead, they took a more creative approach. Their pages were graph paper mosaic pictures! What a rich source of coded drawings they would make!

How can you make a million?

5 by 6

Eugene Daily and Annemarie Garcia

4	3	2	0	0	2
4	1	3	4	0	3
4	2	3	1	0	1
4	2	1	2	2	3
0	4	1	3	0	1

Completely cover this 5 by 6 grid using dominoes:

4 - 3, 2 - 2, 2 - 0, 1 - 0, 2 - 1, 3 - 3, 1 - 4, 4 - 4

2 - 4, 3 - 0, 3 - 1, 0 - 4, 1 - 1, 3 - 2

Mary Contrary's Garden

June Farmer

(This game may be played by using seven (7) beans, peas, pennies, or anything small enough to be held in the hand.)

Mary Contrary was a lover of beautiful flowers. So were her faithful gardeners, Silver Bell and Cockle Shell. Mary Contrary was especially fond of her five (5) little maidens in a row (five items placed on the table). But Mary Contrary liked her flowers left in the garden while Silver Bell and Cockle Shell liked to choose beautiful maids to be placed in vases in their drab shanties. Early one morning Mary was sleeping peacefully in her palace near the flower garden. Silver Bell and Cockle Shell were busy pulling weeds from the little maids all in a row. Silver Bell commented on how decorative the five (5) little maidens would be in their drab shanties. Cockle Shell quickly agreed. They decided to capture the five beautiful maidens.

Silver Bell (show 1 item in right hand) said he should have first choice since Silver is more important than Shell and besides he had the original idea. After much arguing, Cockle Shell agreed. (Show 1 item in left hand.) So they began by choosing the 5 maidens. (Right hand picks first from the five items in a row on the table.) They alternated turns until all maidens had been chosen with Silver Bell choosing the loveliest flower first. (Audience does not see but there should be four (4) beans in right hand and three (3) in left hand.)

As they conceal their maiden flowers and prepared to leave, Contrary

Mary awoke and immediately missed the aroma of the beautiful maidens in her garden. As she entered the garden, Silver Bell and Cockle Shell were trying to escape over the wall of the garden. Quickly Mary noticed her five(5) maidens missing and threatened to call the police if her five maidens weren't replanted while she went in to sip her morning tea. Cockle Shell (shake left hand) blamed Silver Bell for their misfortune and eagerly (left hand first) began to replant the maidens (alternating hands until all maidens (5) are in a row).

However,some time passed after the replanting. They had assumed Mary would return for the inspection of her garden. But when the aroma of the maidens had again filled the palace, she forgot her tea and went back to dream land. Silver Bell and Cockle Shell began to talk of how close they had come to having their drab shanties decorated with little maidens. Again Silver Bell convinced Cockle Shell they should recapture the maidens and to show his bravery he would go first. Silver Bell and Cockle Shell again took turns until all maidens were captured and so was the aroma. Contrary Mary came into the garden again and demanded a count of her maidens -- but she made an amazing discovery. Silver Bell and Cockle Shell were huddled together(left hand) out of fear for their lives while as the five(5) little maidens were in the right hand.

How could this be?

Shapes

Helen Miller

Cut these shapes out of light weight cardboard:

1) trapezoid
2) isosceles triangle
3) equilateral triangle
4) right-angled triangle
5) parallelogram
6) rhombus
7) square
8) rectangle
9) circle

The shapes are put into a large paper bag or box with holes for hands. A child feels the shapes (with both hands and without seeing them) and describes what s/he feels.

Then they can be sorted (either looking or not).

Names should be given only after the shapes are described.

If many shapes of each kind are cut, the child may put them together to form other shapes. Tangram-like activities could be done with tracings of the newly made shapes. For example, can you use only squares to make a square, only trapezoids to make a trapezoid, etc.?

A mirror placed at an edge or midpoint of each shape can provide the beginning for some rich activities in symmetry.

Dominoes

Nova Lee Galvin

0	0	1	0	1	2
0	1	1	2	2	2
0	3	1	3	2	3
3	0	1	2	3	4
3	4	4	4	4	4

This pattern is made by arranging 15 dominoes in a certain way. Each number represents the number of dots on half a domino.

1) What dominoes have been used?
2) How are they arranged?
3) a) Is there more than one solution to the problem?
    b) If yes, how many?
    c) If yes, why is this possible?
4) Using only these dominoes, make a puzzle solvable in only one way.

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SEEDBED

Number 4

February, 1980

Teachers' Center Project
Southern Illinois University
at Edwardsville

INTRODUCTION TO SEEDBED

The New Year is not so new but the decade, relatively speaking, is. Happy New Decade!

We are pleased to publish SEEDBED 4. This issue, as the others, accomplishes three things:

1. It says that teachers are capable of some pretty super thinking. Most of the articles here spring from work done at the River Bluffs, Belleville, and East St. Louis Teachers' Centers during the fall quarter of the 1979-80 school year.

2. It says that teachers sharing ideas with other teachers can be a potent force in the improvement of education.

3. It says that thinking -- by teachers and children -- is not a dying art.

Read and savor what's inside. Be cautious of the tendency to rush from one issue to another. Each issue is susceptible of elaboration by you and your colleagues.

One aspect of education recently shouting itself hereabouts is an increased demand on teachers for greater productivity. Teachers are simply run ragged. Here's the old mechanistic view once again -- put more into the machine, get more out. It sometimes works with machines (until they overload); it's inappropriate in education. Education is concerned with people and ideas and their growth. When will American education realize that it is the mechanistic view, not teachers and and children, who are faulty?

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A second bit of nonsense is the attention given to behavioral objectives (fortunately now decreasing, but I ran into some pre-service teachers who even now are forced to jump on the b.o. bandwagon). In all my experience in education I have been continually impressed by the diversity of responses to a particular stimulus. (What do the following "stimuli" induce in you and your colleagues: 1. R.M. Nixon, 2. Texas, 3. escargots, 4. vanilla, 5. the Los Angeles Rams?) Can we continue to pretend that a stimulus elicits a single response? What incredible simplicity, if not arrogance!

Much thanks to Shirley Casey, who handled most of the editing of SEEDBED 4, and to Theresa Ryan and Cindy Hagler, who did most of the typing. Greatest thanks, of course, to the teacher-authors whose work is contained herein, and to the children who continually give teachers confidence that thinking is a worthwhile activity.

Join us in our work. Join us in the view that knowledge is not a spectator sport.

Edwardsville, Illinois
1 February 80

Thomas C. O'Brien
Professor

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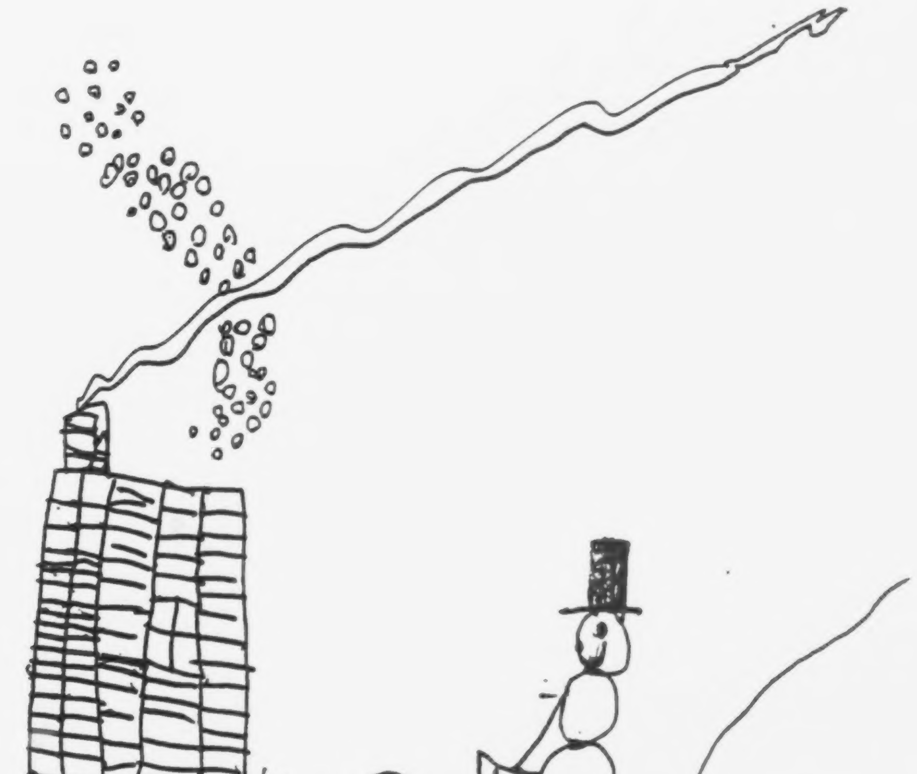
ABOUT THE COVER

The cover art was done by Jason Carroll. The internal art was done by Heather Bristol, Heidi Brugman, Tressa Gipe, Karen Goldenbaum, Jacob Prewitt, and Cassidy Wild. All the children are pupils at The Children's House in Edwardsville, Illinois.

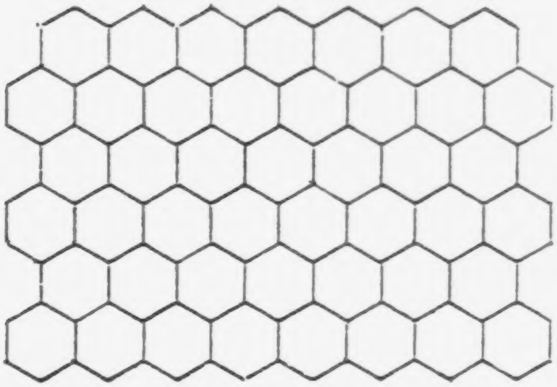


Karen

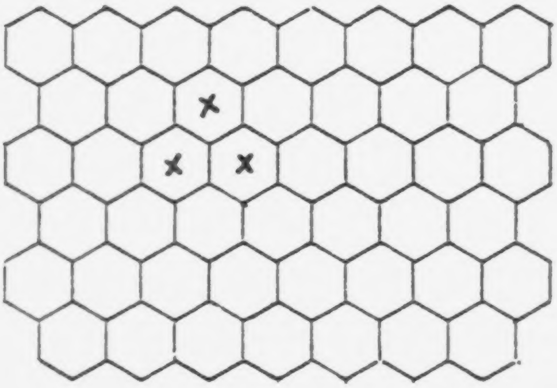
Cluster Games

The East St. Louis Bunch*

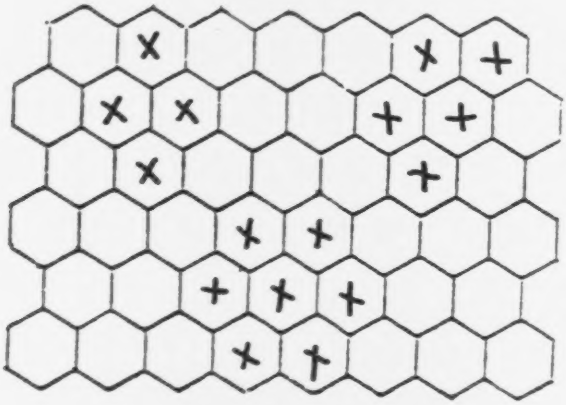
Here are some games on a hexagon board:



1. A game for two players. Each player chooses a different colored crayon or the players may use X's or O's (or two different colored counters) to play the game. Players take turns coloring in one of the hexagons. The winner is the first player to get the most clusters of three's with his color. Here is a cluster of three.

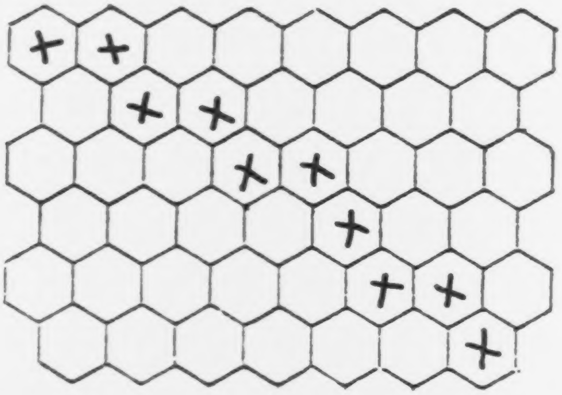


2. The game may be played with clusters of fours, fives, or sevens.

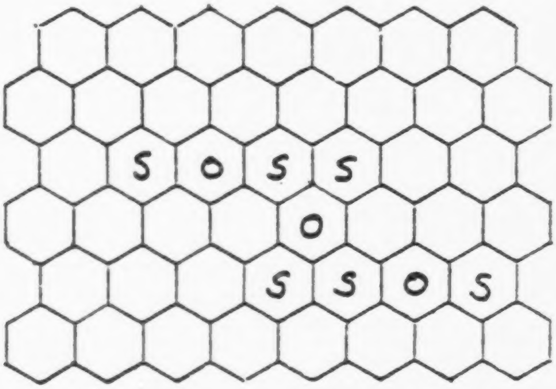


3. The game may be played with one die. Each player colors the number of hexagons that is shown on his/her roll until all of the hexagons have been colored. Each player counts the hexagons when the board is full.

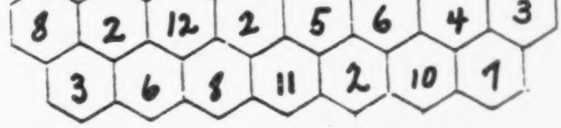
4. The game may be played taking turns coloring in hexagons one at a time. The winner is the first player to get his color to go all the way across from on side to the opposite side.



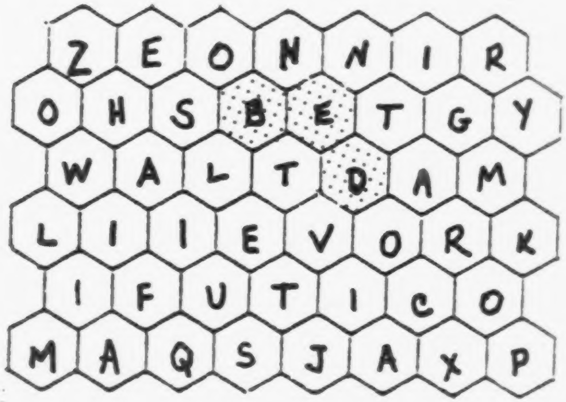
5. The game may be played as SOS, across, vertically, or horizontally. The winner is the player with the most SOS's. (I am S, you are O)



6. Materials: Two dice and two different colored crayons. Game may be played by using numbers from 2 to 12 at random on the hexagons. Each player throws the dice; then decides whether to use number combinations or the sum of the two. (Example: 6 and 2 on the dice can be read as 6 and 2 -- or 8.) Then the player must color in his or her selected hexagon(s). The winner is the first player to color seven vertically or diagonally.


7 9 11 4 10 5 9 8
5 4 2 9 3 6 12
10 7 10 6 12 7 11 3
5 4 9 8 3 9 7
8 2 12 2 5 6 4 3
3 6 8 11 2 10 7

7. The game may be played by using letters at random on the hexagons. Use the letters in the hexagon to form words by uniting the letters with different colored crayons. The winner of the game is the player who makes the most words. This game can be played individually or in pairs.


Z E O N N I R
O H S B E T G Y
W A L T D A M
L I I E V O R K
I F U T I C O
M A Q S J A X P

A page of hexagon paper for teachers' use is supplied on page 5.

*The East St. Louis Bunch includes Diane Anthony, Rosa Danner, Willa M. Orr, Angela Fentress, Nellie Rush, and Jacqueline Silas.

A School-Wide Approach to Language Development

Thomas R. Hoerr

"Wump! Wump! Wump!" No, that's not the sound of a flat tire (or the command of a parachutist with a speech impediment). Wump, according to author Bill Peet in his book, The Wump World, is the sound that the furry wump makes when it is happy. "Wump" is also the sound made by many students at Pershing Elementary School in the University City (Mo.) School District.

"What," you may be asking, "does all this have to do with children's language development?" At a recent SIU-E Teachers' Center workshop (November 15 & 16, 1979), John Bates spent a great deal of time talking about language development. He stressed the importance of reading to students at all ages. (Note: the word students is used rather than children; Bates maintains that all students can benefit from being read to, regardless of reading level or age. He noted that he reads daily to his son, a high school student.) In addition to cultivating an enjoyment of language and facilitating the acquisition of "proper" sentence structure, etc., a student who is being read to finds his imagination taking hold and becoming active. (We all know that the picture hasn't been painted which can compare to the vision held in one's mind.)

Given that reading to students is a very beneficial activity, the question becomes one of mechanics: how and when? Several of the workshop's participants said that while they tried to "pleasure read" to their students on a daily basis, they found their day being folded, stapled, and mutilated by a myriad of interruptions and paper work requirements. There was also a feeling that the amount of time spent reading to students decreases as one advances through the grades. We all agreed that, indeed, reading to students is important and that this was a practice which we would somehow try to implement at our own schools.

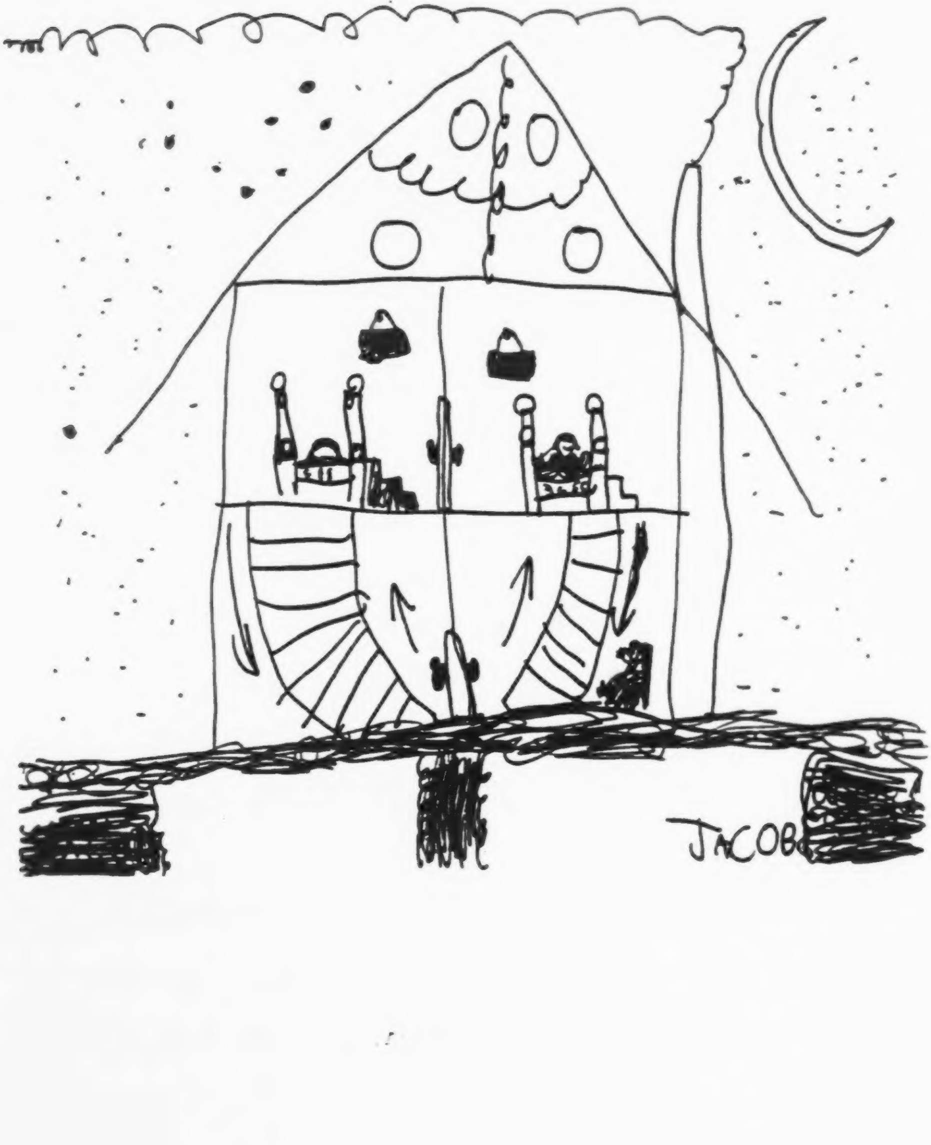
Being a principal, this decision left me in a quandry. As one who is deeply concerned about students' intellectual development I strongly support this notion, but . . . I don't have a classroom of students. A few days later, while preparing to give my daily interruption over the school's P.A. system, the solution came to me. "Eureka," I thought (as my mental tub overflowed) "why not read a story to the entire school over the P.A.?"

Fortunately, I had already allocated some time at our next faculty meeting to discuss the Bates workshop and how we could implement some of the thoughts stemming from the experience. I concluded by explaining John's thinking about reading to children and asking the teachers how they felt about the idea. Although a few were not enthusiastic, the majority seemed receptive and thought it worth a try.

We've been doing it for over a month now and the results have been very positive. Twice weekly we have stories read (8-10 minutes) over the P.A. at 3:10 p.m. I generally try to read primary books. Bill Peet's books are great, Richard Dahl's The Enormous Crocodile was super (I was able to use all those voices that got me in trouble while growing up!), and James Thurber's Many Moons, while a bit more sophisticated, was enjoyed by all.

Simply put, the students really enjoy being read to. Each morning I am beseiged with "Is today a story day?" and strange noises are often heard in our halls . . . Wump! During story time, however, the halls are amazingly quiet (not only could one hear a pin drop, one might also possibly be able to count the number of angels dancing on its head!) Several teachers have commented that their children ask for the stories that have been read, and a couple of students have brought me their favorite books for reading. It's just one step, but I think it's an important one.

Who knows, now that we've found a productive use for the P.A., there may be something we can do with the tab tops from soft drink cans!



Cryptograms -- What's The Code?

Claretha Robinson

Bobby Bean

SEASONS

DHCCMW

SLVFMW

DOWLVR

BHFHCV

HOLIDAYS

UIBDUL

XIQUHDAHU'B TIG

DRIHJBWAXAHW

YUYELAIQ TIG

PRLABDYIB

YEDRUL'B TIG

PEQOYVOB TIG

HUF GUIL'B TIG

SIDRUL'B TIG

AHTUKUHTUHPU TIG

MONTHS

VNCHNQUNK

BMGDMKO

MCKJI

GRPNQUNK

BDIO

MDWDVH

QMO

TNUKDMKO

RSHRUNK

QMKSL

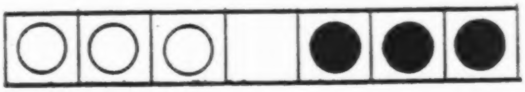
ANSNQUNK

BDGN

Switcheroo

Fred Habermehl

Materials: Game board and equal numbers of chips of two different colors (i.e. red and white). The chips are placed in adjacent spaces in a straight line with the chips of one color on the left, the chips of the other color on the right and an empty space between the two sets.



Object of the game: To get the red chips to the positions originally held by the white chips and the white chips to the positions originally held by the red chips.

Rules: One Player: The player can only move one chip at a time. The chips can move only in one direction; they cannot move backwards. A chip can be moved into an adjacent free space or it can jump one chip of the other color. A chip cannot jump another chip of the same color; nor can it jump more than one chip at a time.

Can you do it? What patterns do you find?

This game was seen at a workshop for the gifted child conducted by Area Service Center, Belleville, IL through McKendree College in the summer of 1979. It was inroduced to the Belleville Area Teachers' Center during the Fall 1979 session.

Catch 21

Barb Leardi

Here are two activities that I discovered recently. They are available commercially as a Hi-Q Puzzle (Gabriel CBS Toys, US Patent No. 79421).

Using the 21 dominoes listed below, complete the two patterns:

1-1, 1-2, 1-3, 1-4, 1-5, 1-6. 2-2, 2-3, 2-4, 2-5, 2-6, 3-3, 3-4, 3-5, 3-6. 4-4. 4-5, 4-6, 5-5, 5-6, 6-6.

5	3	3	1	3	6	5
6	2	2	4	3	1	1
4	4	2	3	2	4	6
1	1	5	5	4	3	6
5	4	1	5	4	5	2
6	2	1	6	6	2	3

3	3	6	5	1	3	6
3	1	1	5	5	1	2
2	2	4	1	1	2	5
5	4	4	3	5	2	6
6	2	4	5	4	3	4
3	4	1	6	6	6	2

Get your local toy store to make these available?

Similiar activities are described in SEEDBED 3, which was produced in Fall 1979 as the result of the Teachers' Center Project Summer Course.

Notes In The Classroom

Claretha Robinson

Ever get frazzled when you're with a reading group and Johnny yells out, "Can I go to the bathroom?", Suzi wants to know, "Can I sharpen my pencil?", and Sam is saying, "Mrs. Robinson, Mrs. Robinson, Billy hit me."? Here's a super idea.

I learned of this idea from Mary Steffen, Commons Lane School, Ferguson-Florissant (she takes part in the River Bluffs Teachers' Center). We met at the John Bates Workshop and later at O'Connell's at a luncheon during the Christmas holidays.

The idea is simply to have children put their requests and interruptions in writing. My class has been a different class since I have started this, thanks to Mary Steffen. And I am a much saner person.

Here are some examples of children's written interruptions.

> Dear Mrs. Robinson,
>
> Donald kept going in my desk and getting my crayons. I ask him to stop but he didn't.
> Mary

> Dear Mrs. Robinson,
> Willie had gave everbody my phone number. Because James had snatch the paper that Carla had and it had my number on that piece of paper. And someone scatch me on the of my face with a pencil.
> Yours truly,
> Carleen Jones

> Dear Ms. Robinson,
> My stumic is hurting. May I you's the bathroom.
> Dorothy

Mrs. Robinson could I borrow a little of your tape
to tape my pencile?
Randy

Ms. Robinson,
She said thank you.

Anita

Mrs. Robinson can me and Rhonda past out the spelling books.

Dear Mrs. Robinson, don't forget we have to write our dairy after we get trew with our spelling.

Your's truly,
Marie

Dear Mrs. Robinson
Randall got dird on my coat and smake me to times out side and in the room. And kick me.
Rose

Mrs. Robinson
Can I come up to the board

May I go buy me a pencil?
Carl

Ms. Robinson, Donald or henry hit me with a peacie of paper, and i did'n do nothind to them.
From Dorris

Dear Mrs. Robinson
someone has been in my desk and got some of my fiesta and i think it is James.
Tom Jones

Mrs. Robinson Ronald hit me in the mouth with an eraser
from Charles

Miss Treplet said you can yous two staples and send
it back to Her.
Jimmy

Mrs. Robinson
May I go to the ladies room.
Tracey

Aside from calmness and sanity, there seem to be several major payoffs from the idea. Children learn to express themselves in writing on issues which are important to them. They sense that their letters are a confidential thing which they like and take pride in. They are still getting the attention which is what most of them are seeking. It provides a situation for the teaching of specific communication skills in which the student is involved. The reading group is enjoying the fact that we are not being disturbed.

I plan later to include a few incidental necessities such as the date and the time of the request, but right now, I don't want to do anything that will discourage or restrict them. And clearly there are mechanics -- spelling, grammar, punctuation -- which need great attention. This we'll attend to as further notes come in.

It is a marvelous idea, teachers. If you don't believe me just try it for a week! I thank you, Mary Steffen.

---

*The names of the children have been changed to preserve anonymity.

Excerpted From
"Science and Mathematics Teaching"

Robert Karplus

Larry McAneny: At the practical end we are faced so often with large classes of people who, I'm sure, do have this great range of skills in reasoning. It's very difficult to treat them differently. What does one do?

Karplus: Yes, a large classroom setting rather than individualized instruction certainly poses a challenge to the teacher. What I try to do is to include in the teaching program activities within which the students can select a level of response that is appropriate to their own thinking. This has the advantage that the students can achieve success in terms of a task that they "make their own" and the teacher can evaluate the level at which the students are working currently from the nature of the response. Why is this a difficult or unusual thing to do in the school? The answer is that most tasks have an expected outcome, a certain answer or a method that is expected as the correct and complete solution to the problem. Most tasks are not sufficiently open-ended that they allow students to select a subtask within a larger range that is appropriate to them.

"Science and Mathematics Teaching" is available from the Teachers' Center Project at the cost of printing, fifty cents.

Children and Mathematics

D. A. Sturgess
S. A. Morley

A great deal of discussion is taking place at the moment on the content of mathematics syllabuses in schools at all levels. Undoubtedly there is a body of knowledge that needs to be passed on to children but in an age when the content is changing at an enormous rate it is necessary to devise a teaching/learning situation of which change is an integral part.

In this situation the teacher needs new criteria. One criterion is the importance of the mathematical idea itself, but it is just as important to ask "what is important mathematical activity for children?" Other vitally important questions for the teacher are how can he foster this activity in children and how can he recognize the difference between activities that are valuable and others that are a waste of time.

This course has been designed to help the teacher to understand himself the nature of mathematical activity and to recognize this in children's activities. Once these ideas are established, then any content which enables the teacher to pursue them is valuable. As mathematics itself changes so will the content of school mathematics change.

There is no really satisfactory definition of what mathematics is, or what we can identify as mathematical activity. Helpful ideas are definitions like "Mathematics is what mathematicians do", because they give the feeling that mathematics is something active. It is something which the learner is actively engaged in recreating, not merely an accepted body of knowledge that he is passively receiving. It is such ideas as 'learning through discovery', and 'investigation' that have helped many teachers to realize that mathematics can be as creative for young children as any other subject in the junior school curriculum. Provided the discovery is the child's own and the investigation a genuine journey towards an unknown goal, children are perfectly capable of creating their own mathematics.

There are some characteristics of mathematical activity that can be fairly easily recognized and these are a few suggestions:*

(a) Formulating the problem in mathematical terms and investigating suitable symbols and/or diagrams -- this is often the hardest thing to do and so we tend to present the problem ready made.

(b) Classifying -- decisions about 'sameness' and 'difference' which are the basis of mathematical concepts and which the pupil himself must make, since you cannot tell someone a mathematical idea, only help him to grasp it.

(c) Making observations, conjectures, inductive generalizations -- Prof. Sawyer has said that mathematics is the study of all possible patterns.

(d) Constructing proofs of conjectures and generalizations; not just learning someone else's proofs -- beginning in the primary school as a conviction of a truth and the attempt to convince others of its truth, and growing to know different types of acceptable proof, when something has not been proved, and more rigorous levels of proof.

(e) Extending the problem, varying the conditions, asking 'what would happen if ----', seeking generalizations.

(f) Taking particular cases if general cases prove difficult.

(g) Using existing literature -- classifying the problem and so recognizing its similarity to problems already solved and bodies of known theory; making use of theorems or methods from the literature to solve the problem.

(h) Systematising -- collecting a known group of results into a logically ordered system -- this is a late stage in a topic.

Perhaps the nearest approach to this essential element in mathematical education is found in those schools with a tradition in which problem solving plays an important part in mathematics teaching. We must note, however, that there is a total difference of approach between problems set as exercises on specific ideas which are being learned (of which the aim is to establish the ideas securely) and problems which exist in their own right, for their own intrinsic interest, and for the solving of which no particular method is specified. Even a 'good' problem in the sense that it may involve the pupil in (c), (d), (e), (f), and (g) above is lacking to the extent that the choice of problem was the teacher's. This deprives the pupil of experience of (a) and (b); the device of 'open' mathematical situations from which pupils can generate their own problems has been used with some success to give opportunity for these aspects of mathematical activity. An example is to give the pupils a pile of cut-out inch squares each, see what they do and what problems suggest themselves, and allow these to be followed up.

Changes in the approach to teaching have followed partly from the recognition of the conceptual nature of mathematics, and partly from the increased knowledge of how children learn. Both of these have led to a changed view of the teacher's role. The authority of the teacher lies in his knowledge and wider experience, but the truth of the mathematics must come from the subject, not the teacher. The pupil has to say 'yes' to the mathematics himself, not accept it as true because 'teacher says so'.

Mathematics is concerned with ideas and relationships. These are 'abstract' in the sense that they exist in the mind and have to be abstracted from some situation. We cannot 'tell' anyone an abstract idea, only help him to grasp it by trying to make the choices on which the idea is based explicit, and by involving him in making these choices and following through their consequences. If this is true then the emphasis must be on the individual's learning rather than the teacher's teaching. This is not to say that the teacher is unimportant. On the contrary he creates the physical environment in which the learning is to take place, and the attitude he takes to questions, suggestions and discussion greatly affect the quality of the learning. But every individual must create or re-create the idea for himself; we cannot hand it over ready-made like a parcel! One valuable aspect of Piaget's work is that he has begun the task of analysing the growth of children's thinking about a variety of mathematical ideas. In this he has stressed the importance of physical 'actions' which become internalized in thought. A further point is that if we are finding out something for ourselves, and are actively involved, our interest is more likely to be aroused and sustained, and the efficiency of the learning is greatly enhanced. This has been shown to be true both in the effectiveness of transfer to other situations and in the ability to recall the material at a later date.

There is an 'inner' aspect of mathematics which is its chief attraction for the many who take pleasure in the patterns which it creates and the problems it poses. But there is also an 'outer aspect'. The mathematics a child learns can add something to his life either by providing a new tool by which he can interpret or order his experiences, or by giving some added insight into the physical or social world in which he lives. Hence the value of mathematics which arises from projects, topics and interests of all kinds which do not carry the label 'mathematics', as well as in other areas of the curriculum such as science and geography where there are obvious uses of mathematics. For the very young children it appears that learning takes place most effectively when it is developed from children's play and interests.

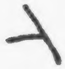
*The headings (a)-(h) are adapted from Teaching Mathematics: Main Courses in Colleges of Education, A.T.C.D.E., 1967.

This article was taken from A.T.M. Supplement No. 22, February 1979 and is reprinted by permission of the authors. Jan Stanfield brought this article to our attention at the 1979 Summer course of the Teachers' Center Project.

Mirror Alphabet

Helen Miller

Use a mirror with these letters to find others:

c	change "c" to "o".
	make letters, "H" and "A".
/	make leters, "v" and "L".
b	Can you make an "a", "d", "B" with this letter?
n	Make this "n" into an "m".
u	Can you change "u" into "a", "m"?
t	Can you change this into "x", "v"?
e	Make this into an "o", "c".
s	Make this into a number 3.
f	With this letter can you make a heart?

Why Do Schools Administer Standardized Tests?

John D. Williams

Why do schools administer standardized tests? If the question is asked of students, a plethora of answers may be given. One answer that probably does not occur very often is, "To help us where we have problems." If a teacher is asked this question, a likely response is, "My principal forces all teachers to give them." Central office personnel may either resort to the "district policy" answer, or perhaps indicate that the "public" expects the schools to be accountable. A most unlikely answer is, "Because it enhances the learning activities in all classrooms." If Perrone's (1975) experience is typical (and there seems to be no contrary evidence), then the scenario just described may be apt:

> As this eventful week came to a close, I called an assistant principal at a junior high school in yet another school district, opening the conversation with, "How are things going?" His response was not what I had anticipated.
>
> "Terrible!" he exclaimed. "We gave the ____________ test on Monday and Tuesday, and the school year hasn't settled down yet. It's like this every school year.
>
> "Why do you give the test?" I asked, but I knew why: it was a systemwide activity. Then I asked what was done with the test results, and the assistant principal said, "We just file them away; no one looks at them." (Perrone, 1975, p. 97)

This excerpt is taken from John D. Williams, Testing and the Testing Industry: A Third View. Grand Forks, N.D.: North Dakota Study Group on Education, 1975.

Basketball Tournament

Fred Habermehl

We have been trying to increase thinking skills in our classes this year, so we have been doing mind benders for some time. Here is one that two of my basketball players came up with. It was well accepted by the class and was completed by most of the class.

Morris School was involved in a five day basketball tournament. They were scheduled to play one game a night for five nights, starting on Monday and ending on Friday. Use the clues to figure out what night Morris played each team.

1. They did not play Dupo on Monday or Tuesday.
2. They played St. John's before they played Dupo.
3. They played Columbia before they played Millstadt or Belleville, but after St. John's.
4. When they played Belleville, Belleville had at least one more day to play.
5. Millstadt played Morris on Wednesday or Thursday.
6. They played Belleville after Millstadt.

What was Morris' schedule?

	Monday	Tuesday	Wednesday	Thursday	Friday
Dupo					
St. John					
Columbia					
Belleville					
Millstadt					

Johnny Struggles With Multiplication

Evelyn Jacob

We were working on a rate chart in school one day. One of the boys named Johnny, a fifth grader, seemed to be having a little difficulty. So while the others were busy working, I took Johnny alone and decided to work with him.

This is what the chart looked like:

NUMBER OF PENCILS	2	4	6	12	16	20
COST PER TWO PENCILS	15¢	30¢				

Johnny was able to see that 2 pencils cost 15¢ and 4 pencils cost 30¢ and then 6 pencils would cost 45¢.

I asked Johnny how he knew for sure and he said, "Because I just do." Then I said, "Show me how you know."

Johnny took 2 pencils and put 15¢ on a piece of paper above these 2 pencils. He then took 2 more pencils and put 15¢ on a piece of paper above these 2.

He then said, "I have 4 pencils and two 15 centses and these two 15 centses equal 30¢."

I then asked him to show me how he knew that 6 pencils cost 45¢.

He went through the same process again. Above 3 sets of 2 pencils in each set he put 15¢. He then added the money together:

$$\begin{array}{r} 15¢ \\ 15¢ \\ 15¢ \\ \hline 45¢ \end{array}$$

"See," he said. "This is how you get 45¢."

In the flow chart, the next problem was, how much would 12 pencils cost?

This is when Johnny didn't know what to do. So I asked him to tell me how much 8 pencils would cost and we went through the same process again. He made 4 sets of 2 pencils each and then added: 15¢ + 15¢ + 15¢ + 15¢ and got 60¢.

I then asked Johnny to tell me how much 10 pencils would cost. His remark was, " Do I have to go through all that again?"

I said, "If you want to know how much 10 pencils cost, I guess you do."

Whenever Johnny would go back and count how many pencils he had he would count, 1, 2, 3, 4, 5 . . . etc. This time, when he counted the pencils, he counted: 2, 4, 6, 8, and 10. I asked him why he was counting this way and he said you could count by 2's because there were 2 pencils in each set.

When he figured out the cost of the pencils this time, he put 15¢ on the board and then counted that he had 5 groups of 15¢ and then multiplied 5 X 15¢ to get 75¢.

I asked him if he was sure that 10 pencils cost 75¢ and he said yes. Then I said, "How do you know?"

He said, "I have five 15 centses, so I can multiply 5 X 15¢ to get 75¢.

Then I said, "Can you show me for sure that 5 X 15¢ = 75¢.

Johnny then added 15¢ + 15¢ + 15¢ + 15¢ + 15¢ = 75¢.

The next question was: "How much would 12 pencils cost at 2 pencils for 15¢?"

Johnny's reaction was, "Oh no! Not again!"

Standing at the board for a few minutes, Johnny then said 90¢.

"How do you know, Johnny?"

"Well, 12 pencils is 2 more than 10, and 2 pencils are 15¢, so I added 15¢ to 75¢ and got 90¢.

"Well, Johnny, if 12 pencils cost 90¢, what would 16 pencils cost?"

With a look on his face as if to say, here we go again, Johnny started grouping pencils into sets of 2 again. Instead of multiplying, Johnny added eight 15 centses and came up with $1.20.

I asked him what he did.

He looked at me and said, "Well, can't you see?" Then he said, "I have eight 15 centses and added them together and got $1.20." He thought for a moment, and said, "Hey! I can multiply 8 X 15¢ and get $1.20."

"Yes, Johnny, you could do that." So he did, and got $1.20.

"Now we have one more problem, Johnny. How much will 20 pencils cost?"

Johnny's remark was, "Is this the last time I have to do this?"

"Yes."

So Johnny proceeded to put 20 pencils in groups of 2 and wrote 15¢ above each group. After doing all of this, he said: "I have 10 groups of 15 centses and he multiplied 10 X 15¢ to get $1.50.

I asked him to show me how he knew this was right and he added ten 15 centses together to get $1.50.

Observations

1. At first, Johnny used the adding method to get the correct answer.
2. Up until the fifth try, the child was counting by ones.
3. On the fifth try, Johnny started counting by 2's and then was able to see that he had 5 groups of 2.
4. With the 5 groups @ 15¢ each, he knew he could multiply 5 X 15 to get the correct response.
5. By the last time, Johnny was able to see that multiplication was a shorter way of adding.
6. Being able to manipulate the pencils and putting them in groups of 2 with the total above each, helped Johnny organize his thinking and made it easier to see that he had X number of groups and could multiply to get the desired result.

Possibility Searching

By the East St. Louis Bunch

Diane Anthony
Bobby Bean
Norma Crowell
Rosa Danner
Angela Fentress
Rosie J. Fisher
Billie Johnson
Wallace King
Lillie Mixon
Willa Orr
Claretha Robinson
Nellie Rush
Jacqueline Silas
Elizabeth Thomas
Diann Williams

MEAT is a pretty good word. It yields lots of other words:

TEA
A
AT
ME

and so forth.

How many words come from MEAT? Can you find a better four-letter word for yielding other words? All the new words must use letters from the original four-letter word and all the words generated must be real words, i.e. found in a standard American dictionary.

A Little Problem Solving

By the East St. Louis Bunch (see p. 26)

We started by monkeying around with a problem which one of us had been using in class:

Fill in the grid with numbers, duplicates allowed -- so that each of the rows (⟷) all the columns (↕) and the diagonals add up to the same number.

Monkey around a bit yourself. What do you find?

By trial-and-error we each came up with three or four

3	7	2
3	4	5
6	1	5

5	2	8
8	5	2
2	8	5

6	10	5
6	7	8
9	4	8

Then we played with this:

6	7	

Given the 6 and 7, aim for 21. Here we quickly saw that the 8 was forced (see 1) and that if the top right corner were chosen (for example with a 5; see 2) all

6	7	8

(1)

		5
6	7	8

(2)

		5
6	7	8
		8

(3)

6	10	5
6	7	8
9	4	8

(4)

the rest of the grid was forced; that is the bottom right 8 had no wigglewobble about it (see 3), nor did a 6 in the top left, a 10 in the middle top, a 4 in the middle bottom, and then a 9 in the bottom left (see 4).

Or starting again with the 6 and 7 (and the forced 8, see 1) suppose we chose an 8 for the top right (see 5). Then the rest of the grid would be forced (see 6).

		8
6	7	8

(5)

9	4	8
6	7	8
6	10	5

(6)

So far, so good. We wondered, given the 6 and 7 and 21 as a target, how many different grids were possible. One hypothesis was that the possible choices for the top right corner, each of which forced the rest of the grids, simply needed to be counted. That is, see figure 1, the top right corner could range from 0 (forcing a 13 in the bottom right) to 13 (forcing a 0 in the bottom right) so there were 14 possible grids (and perhaps some duplicates; we'd clean up that issue later), each of them determined by the top right numbers 0, 1, 2, ..., 13.

But if you try sticking in a 0 in the top right (see 7) you get a forced 13 and 1 and then a forced 20 (see 8). But the 20 and the 7 total more than the target, 21. Yes, there are 14 possible grids, each forced by the choice of the top right number, but some of them lead to trouble. How many grids, starting with the 6 and 7, do yield 21? What's going on here?

		0
6	7	8

(7)

1	20	0
6	7	8
		13

(8)

We kept the 6 and 7 as given and tried for targets other than 21. How about 20? (see 9)

6	7	

(9)

6	7	7

(10)

		7
6	7	7

(11)

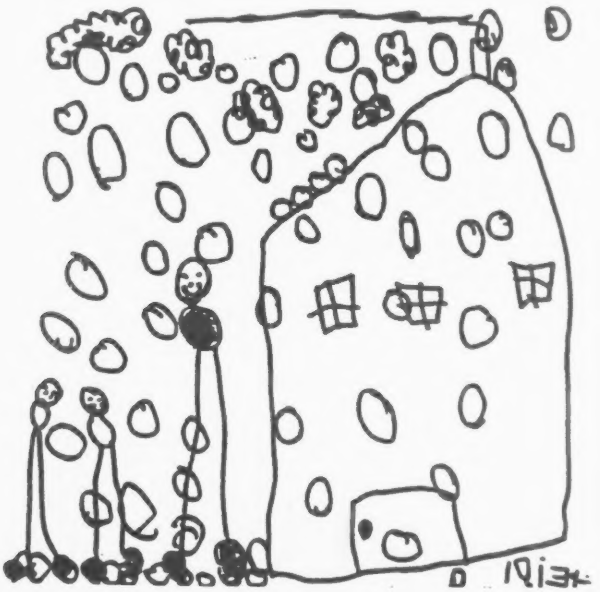
Here the 7 is forced (see 10). Then a choice of 7 for the top right corner (see 11) yields 6, 7, 6, and 7 (see 12).

7	6	7
6	7	7
	7	6

(12)

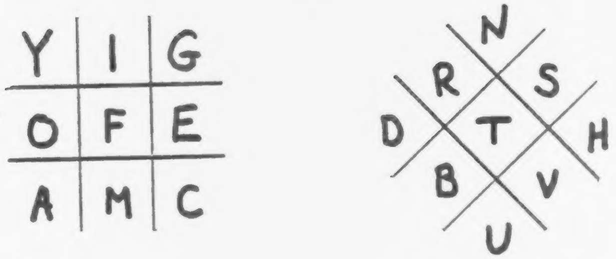
Now for the left bottom. Oops.

So the question we leave you with is given the 6 and 7, is any target other than 21 possible??? What about the earlier problem? How many different 21's are possible?



A Message For You

Mary Blair
Ruby Mack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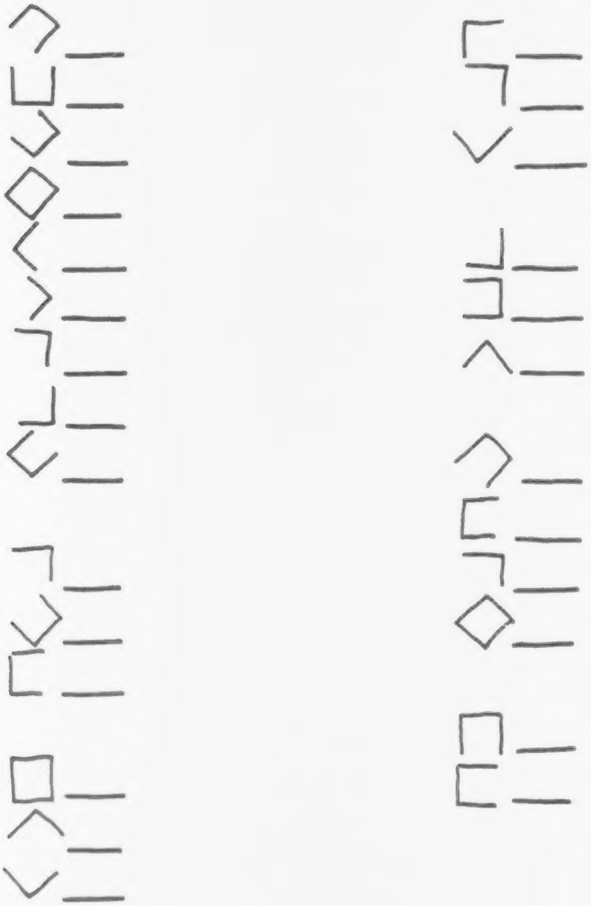


The Communication Arts in the Classroom
A John Bates Seminar

Irene Armbruster
Anne Bailey
Gloria Blaes
Vera Debolt
Jan Gass

War on words, diaries, mailbox in the classroom, tribal booklets, children as authors -- these are just a handful of activities presented by John Bates to stimulate communication in the classroom. On November 15 and 16, John Bates (Board of Education, Toronto, Canada) held a seminar in Belleville, Illinois, dealing with communication arts.

Communication arts -- defined as listening, speaking, reading, writing, music, drama, and art -- can take place with different sorts of intent. Six kinds of communication intent cited by Bates are the following:

1. Self-maintaining: protection of one's person and interest;
2. Directing: dictating the actions of others and self;
3. Reporting: stating and analyzing the facts as they occur;
4. Logical Reasoning: explaining, justifying, reflecting, and drawing conclusions;
5. Predicting: self-explanatory;
6. Projecting: empathy.

Communication -- however it takes place -- has various audience characteristics as well: personal; interpersonal; tribal; unknown perceived audience; and non-perceived audience. One can build a curriculum around this intent X audience matrix.

For personal communication, it was suggested that children start personal diaries as soon as possible. For very young children, this can take the form of drawing pictures on calendars (to note special days). Picture journals can then be converted into written journals when children are able to do so. Ten minutes of private time should be set aside for this activity each day. Optimally, the teacher can be an artist as well, working on the same tasks as the children.

Interpersonal communication gives a child a purpose for writing and reading. A note-writing activity, using a classroom mailbox, not only eliminates note-passing but allows and encourages students to write letters to others. This system of communication is available any time. Mail call takes place once a day. The letters are private unless the receiver wants to share them. Other activities are partner-reading and shared listening (interpreting another person's verbal communication).

One tribal situation which was described by Bates is the classroom where the teachers and students work as a unit. In the tribal situation children do much of their reading, writing, listening, and speaking. Through tribal reading, students are exposed to poetry, prose, diaries and other forms of literature. A very important underlying point that Bates stressed was that the new exposure would show up in the thinking and behavior of the students some fourteen months after the first encounter. For example, a child who is exposed to a story about knights and dragons is likely not to dramatize knights and dragons until fourteen months later.

Tribal reading should be an enjoyable situation. Books such as comic books, low-level books, fun books, and easy reading materials should be available. Reading by the teacher is another essential part of tribal reading. Teachers, says Bates, should read to kids at least a half hour each day. Whereas the teacher may be the tribal reader, she need not be the only one who imparts information. Through show and tell, the child can impart information, as well as experience the challenge and reward of talking to a group. In those cases where the tribe is ignoring him (always possible) the student will become aware that he needs to make his material more interesting to capture the attention of his audience.

"Children as Authors" is an activity where the students choose a subject of interest to them, research it, and write a book on it, including illustrations. Uncorrected and unedited, this book is then taken to the school library to be professionally bound, registered and accepted as a book to be checked out and read by anyone interested. This gives the student a chance to expand his own interests and to develop a sense of pride in his work. As a side thought to this, Bates stressed that corrections or grades should not be written on the child's paper. (No teacher has a right to deface a student's work.)

To cope with spelling in the Toronto schools, the administrators and teachers allowed the students to choose their own spelling words. These words were chosen from the students' written assignments and reading materials. At first, there were 450 commonly misspelled words. From these, a 50-word spelling test was given each Friday and children were asked to set their own target -- "I'm going to aim for 22 words right this time." After a few months, the students' spelling had greatly improved and it was difficult for the teachers to collect 50 misspelled words from the children's work.

Students should become aware of communication with an unknown perceived audience. For example, they can advertise and promote some future school event, such as a bake sale. At the adolescent level, a demographic questionnaire allows development of oral, written, and reading communication skills. Close scrutiny of the media (awareness of the reality and the honesty of program scripts) also makes the children aware of other's attempts to communicate with an unknown perceived audience.

The last level of the taxonomy involves communciating to a non-perceived audience, again through written or spoken material or even mime. Written material is a publication which might be read by anyone, therefore, words need to be selected carefully so as to translate a correct interpretation. The broadcasting media is one form of dealing with a non-perceived audience; public speaking is another. Cannot children prepare for this?

Communication arts is an important part of every school curriculum. Educators need to observe and be aware of the students' individual needs and interests while teaching. John Bates suggested that we take these general ideas into the classroom and allow them to grow.

Much of Bates' comments were drawn from the work of James Britton and Joan Tough, Britons whose work needs to be more fully known by American teachers.

'Process Approach' to Compositions Receiving Increased Attention

Burton Albert Jr.
The New York Times

Elementary school English teachers in East Brunswick are no longer asking children just to fill in blanks, to name parts of speech on ditto sheets, or to write on topics they know little or nothing about. Neither are the teachers red-penciling rough drafts as if they were manuscripts crossing an editor's desk.

Instead, the teachers are guiding pupils through the stages of composition as experienced by professional writers. The method is known as the "process approach" to the teaching of writing. It has been in use in various parts of the country for the last decade and has recently been receiving increasingly serious attention.

Pupils are shown how to find and develop subjects. They use their imaginations, books and other resources. They are taught to write with their senses, to stockpile information and to use words as symbols to convey that information.

After the pupils write drafts, they revise and revise to discover exactly what they want to say. Finally, they make their writings available for classmates and others to read. For the teacher, close reading is reserved for well-developed papers on a variety of topics, not for the mountains of first drafts.

In East Brunswick, the change began two years ago when Louis J. Hebert was appointed assistant superintendent of educational and administrative services.

Little Teaching of Writing

He discovered that little time was being spent on the teaching of writing and that money allocated for elementary language arts--excluding reading--amounted to less than a dollar a student. This meant that composition had to share the pennies with handwriting and spelling.

Mr. Herbert also knew that in New Jersey, an English teacher could be certified with 30 hours of literature, three hours of linguistics and perhaps three hours of advanced composition.

"It is hardly sufficient background for teaching children how to write," he said.

"It is especially inadequate when you realize that writing is the single most effective tool for learning," adds Dr. Marian Toth, English coordinator for East Brunswick schools.

Under their leadership, East Brunswick has begun to funnel money into in-service training. For the most part, it has consisted of workshops in which the teachers themselves write under the guidance of professionals.

Support From Administration

Support has come from the school administration, a strong Parent-Teacher Association and the Board of Education.

"The whole joy of education is putting yourself in touch with all your senses, feelings, emotions and thoughts," said Donna Wilshire, a member of the board. "Writing--being able to identify those things so you can touch them for yourself and communicate them to others--is the whole point of being in school. That's basic. For if we don't write, then all of those things we each have are lost to us."

Pupils in the Warnsdorfer Elementary School are beginning to mirror that point of view. They write about their own experiences. They tap their memories. They research topics teachers lead them to--by questioning, listening and responding.

The pupils also exchange, revise and proof-read drafts after comments by their classmates and instructors.

"A few years ago we were doing the poorest job in the teaching of writing," said Philip Hauser, the principal. "It was fragmented and minimal. Now the kids are having a ball."

Sophisticated Language

"They're becoming much more critical of each other's work and of their own work. The kind of language they are using is tremendously sophisticated. And although the teachers are having to curb their desire for immediate results, they are much more analytical about the kids' papers and selective about the materials they use."

Mr. Hauser also points out that, despite less drill on mechanics and usage, which are stressed in conventional achievement tests, the pupils' scores have remained consistently high.

"Of course my basic concern is the end product," he said. "Yet there are many ways of getting there. Grammar and punctuation are taught as they come up in a real situation, not one that's fabricated."

A visitor to Judith Fredenburgh's sixth grade class still hears references to nouns, verbs, commas and capital letters. But as Mrs. Fredenburgh and her students discuss their papers, a visitor also hears these things:

"Be specific."

"Show, don't tell."

"Use all your senses."

"Try a zero draft."

"Get a good lead."

"Make the reader believe."

"Find a stronger verb."

This article is reprinted in its entirety from the January 1, 1980 New York Times. Reprinted by permission.

"Last Christmas," Mrs. Fredenburgh reports, "a number of my students asked for a thesaurus."

One student, Marni Smilow, grew so excited about a story she was writing that she kept making notes while trying to play soccer. She couldn't wait to get home to draft this passage:

"I awoke with a start and looked at the clock. It was 6:30 A.M. I had to have Lightning in the truck by 9:30. I dressed in my jeans and a T-shirt and rushed out to the barn. Lightning was quietly munching hay, while Uncle Jack stood nearby.

'"I'm glad you're here,'" he said. '"I'll be with Jenny if you need me.'"

"I got out the brushes and started to curry Lightning. I guess she sensed the excitement in my strokes because all at once she let out a snort and started pawing the ground. I talked in whispers until she calmed down.

"I trimmed and braided her mane, tail and forlock (sic). I brushed her till her fur shone like black diamonds, and washed away the sleep that had accumulated around her eyes. Soon she looked like a show pony."

A parent, Maxine Chodroff, had this to say:

"For my son, who didn't have the advantage of this approach, I had to hire a tutor. But my daughter and her friends are doing phenomenal work. They are not afraid to write. They don't copy directly out of an encyclopedia. They know how to use words and how to analyze an author's message. They have gained a great deal of self-confidence."

'Extension of Our Being'

As Dr. Toth often tells her staff: "Writing is an extension of our being, and as children acquire mastery in writing, they acquire competence and belief in themselves. Success in effective communication is also success in personality development."

The system's other principals besides Mr. Hauser also support the process approach, in a variety of ways--from participating in writing workshops to arranging "writing fests" and using amplifying systems to broadcast pupils' work.

Currently, the principals are implementing the following set of guidelines they adopted last summer:

Require every teacher to keep folders for student writing, collect the folders periodically, skim through the contents, respond with brief oral or written comments to the teacher and sometimes to the pupil as well.

Have every teacher respond to drafts and insist upon neat final copies, with at least two compostions and the original drafts placed in the pupil's folder each month.

Encourage teachers of all disciplines to stress writing when appropriate.

Display the pupils' works because writers need readers.

Schedule observations of composition lessons and check for the teaching of prewriting, revision and final drafts of compositions.

Stress the teaching of language through composition. Children learn and retain very little from the mechanical practice of correcting adult-prepared written mistakes in grammar, mechanics and usage. They do learn the correct forms of language when they are taught the skill in the context of their own work.

Encourage teachers to learn more about the process of writing.

Final Drafts

Me the Star

I am a star,
Shining as bright as the sun
With birds flying past me so fast
I can feel the breeze.
I shine brighter at night,
Even brighter than the moon.
KEVIN MCBRIDE

Grade 4

Puppies are squirmy
And wiggly and cuddly
Their feet are mud-puddly.
They strew things
And chew things,
In puppy dog prankings,
And waggle their way
Out of scoldings
And spankings.
STUART FREEDMAN
Grade 5

A Frosted Rainbow

I see the sun
Shining through a rainbow
Emerging from the sky
Flowing into the green grass.
Fluorescent, frosted colors of
Red, yellow, orange, pink
Striped into a rainbow
Full of life.
JULIE BERISH

Grade 6

Block-It

Jeanne Edgar

This is a game for two. It takes approximately 15 minutes but 3 or 4 can play if more time is available.

Each person gets about 25 markers or squares of paper. Each person needs a different color. The object of the game is to get four squares in a row horizontally, vertically, or diagonally on a Block-It board. The first person to do so wins.

The game starts by one person rolling three dice. This person can add all three dice together, multiply all three together, or any combination of adding and multiplying.

Ex: Numbers shown on dice are 2, 3, 5

The possibilities are:

2 + 3 + 5 = 10
2 x 3 x 5 = 30
2 x 3 + 5 = 11
2 + (3 x 5) = 17
(2 x 5) + 3 = 13
(2 + 3) x 5 = 25
2 x (3 + 5) = 16
3 x (2 + 5) = 21

The person may cover only one of these results at a time. If the space is already covered then the person must select another. If all 8 possibilities are covered then the person looses his turn.

The game is called Block-It because a person can play defensively and block the opponent.

B	L	O	C	K	-	I	T
1	2	3	4	5	6	7	8
9	10	11	12	13	14	15	16
17	18	19	20	21	22	23	24
25	26	27	28	29	30	31	32
33	34	35	36	37	38	39	40
41	42	44	45	48	50	54	55
60	64	66	72	75	80	90	96
100	108	120	125	144	150	180	216

Reprinted From The New Yorker (1/7/80)

POPE LAUNCHES
TALKS TO END
LONG DIVISION

-- Headline in the Pomona (California) Progress Bulletin

As millions of fourth graders cheer.

Excerpts From
"What is Basic? -- A Constructivist View"*

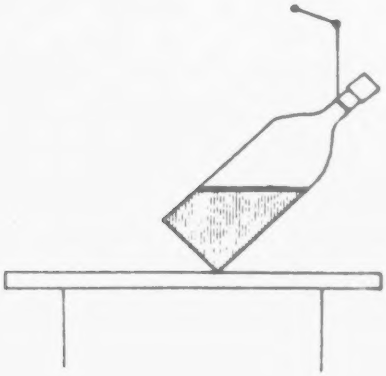
Thomas C. O'Brien

Such a view -- a constructivist view -- sees people as active, rather than passive, in dealing with reality. It sees knowledge as a construction, not an accumulation. It sees people not as controlled by "stimuli", but as controllers of the stimuli in the sense that they select and interpret and re-form the stimuli. It sees ideas as complex networks growing and alive, not as straight lines. It sees the main intellectual activity of people as organizing and it sees the organizing we do -- starting from the touching and seeing and sucking actions of the newborn through to the elaborate equation-making of the adult physicist -- as tending toward coherence, stability, economy, and generalizability. Finally, it sees the mind of man as not satisfied when it has achieved coherence but as questing, as actively searching for and creating novelty to engage, dissonance to conquer, risk to take. The mind is an organism, not a mechanism.

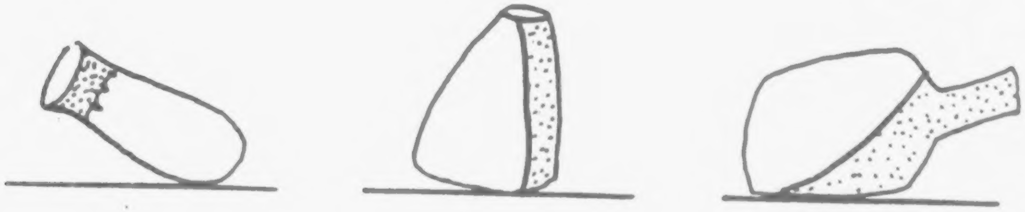
* * *

The method of research is often surprisingly simple. Much of the research involves careful observation of individuals as they solve problems. How does the infant reach for a rubber duck placed near his right hand when he already holds a rubber frog in his right hand and his left hand is free? (He drops the frog and reaches for the duck with his right hand; up until 6 months or so, infants rarely reach across the mid-line.[1]) How does the child formulate the rules for a game of marbles? How does the seven year old infer how many candies are hidden if he saw 10 originally, some were taken, and he now sees three? What's the four year old's/ the seven year old's/the twelve year old's answer to the question, "Why do clouds move?" How does the ten year old/the eighteen year old define "propaganda"?

The results are often particularly striking. In one research[2] children were shown a drawing of a bottle (or an actual bottle) partly filled with colored fluid.



Then, an hour later, a week later and six months later, they were asked to draw what they had seen. What commonly happened was that children drew situations that they had not seen and could never have seen because they could not, in fact, exist in the real world.

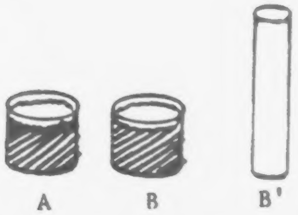


Findings of this sort (and they are abundant) make it clear that the mind is not a camera, that the mind selects, interprets, and reconstructs what comes to it in terms of its existing mental networks. Moreover, the findings show developmental change. In the research cited, 30 percent of children progressed at six months (without a new look at the bottle), 53 percent remained the same, and "in general, correct drawings after one week remained correct after six months".

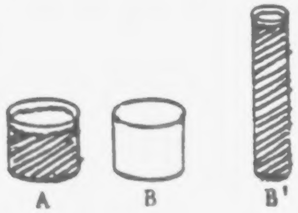
The research -- sixty years worth in various cultures on a wide range of issues with the same general results -- suggests that one's present construction is at once the coordination and elaboration of previous constructions and the springboard of new constructions to come. Here is a sketch of some of the main aspects in the flow of events of the development of thinking.

* * *

Coordination plays an important role in other affairs as well. A series of classic experiments shows the child's thinking. Fill two jars with colored water as shown:



Then pour B into B' as shown and ask which jar has more.



As with the earlier construction of object invariance, here the child constructs -- over the elementary school years -- the notion of the invariance of properties (in this case, volume) of objects. Younger children commonly say that B' has more, though they freely admit that when B' is poured back into B, the volumes are the same. They tend to be dominated by the looks of things, to center on one dimension (here height) rather than to coordinate dimensions, and to lack a sense of reversibility. How are fluids packaged and displayed in retail markets, by the way? How do advertisers emphasize percept over concept?

* * *

The period of elementary school coincides with the child's construction of thought operations in which concept triumphs over percept, in which children decenter from their own point of view, and in which coordination of variables and the reversibility of arguments becomes established.

* * *

Memory and Knowledge. An increasingly common view of memory holds that there are several different kinds of memory -- memory in the strict sense (I remember that George Washington was born in 1732.) and memory in the wide sense (I remember that the capacity of a jar isn't determined merely by the height of the jar.) Additionally, there are different types of retrieval -- recognition ("Didn't I see you at the picnic last week?"), recall (Who was the twelfth President of the US?) and reconstruction (31 x 20 is 620 because 30 x 20 is 600 and 31 is one more than 30.)

Related to these distinctions is the distinction between knowledge in the narrow sense and knowledge in the broad sense. A child can "learn" number facts, for example, by rote -- chant them over and over again -- and the chance is pretty good, in the short term at least, that he can recall them. (Though one of the commonest complaints of teachers is that children return from summer vacation remembering little of what they had learned in June.) It's unlikely, however, that he can reconstruct number facts if strict memory fails.

On the other hand, if the child constructs number facts in a relational way (2 + 3 is 5 because 2 + 2 is 4 and 3 is one more than 2, for example) he can reconstruct the 2 + 3 if need be. He can use memory in the wide sense to help him out. Moreover, knowing that 2 + 3 is constructible suggests that 1) knowledge is something other than random facts to be stored, 2) it's something one has control over, and 3) old knowledge is capable of being combined to make new knowledge.

* * *

In general it is self-regulation, where the child -- or the adult -- engages a situation, assimilates it and accommodates his mental networks to it, which is most central to learning. Intellectual development is a form of adaptation and learning in the wide sense is provoked adaptation. It should be clear, by the way, that the match-up (better, moderate mismatch) between the new situation and one's present mental networks is critically important, as is the context in which the new situation occurs.[4] This is where teachers and parents play their role, lest children be left to the random events of everyday life.

* * *

Basics. What, then is basic, in the school education of a child? Perhaps it is helpful to distinguish between knowledge in the narrow sense and knowledge in the wide sense and to realize that the two can be mutually supportive. (They can also be mutually indifferent, even destructive.)

There are dangers at both extremes. Knowledge in the narrow sense can amount to laundry lists of trivial or atomistic facts or to a surface layer of "right words" with few, if any, underpinnings. And the notion of knowledge in the wide sense can be so airy-fairy that it has no substance, gives no direction to educators, amounts to vague -- though well-intentioned -- generality.

A developmental constructivist would take a wide view of what is basic. He would see self-regulation as basic. That is, children should be prepared to deal with the problems that arise in their world, even though much of their future world is unknown to us at present. Further, they should be self-sustaining. They should not wait for nutriment to come to them; they should be able to find their own nutriment. They should, in general, develop an internal road-map of the world which is coherent and stable and useful and open to new growth.

A constructivist is likely to be more concerned with the child's construction of thinking abilities than with the discovery of the structure of content (or with the passive storage of structure, as was often the case). It is suggested that Davis' statement be revised:

> *If instead, we seek those basic operations, techniques, and attitudes which play important structural roles in the intellectual growth of the child, we have a far more powerful approach. For all the rest of his life the child will be able to continue to build a coherent road-map of reality, one which enables him to construct and test relationships, to infer, and to withstand the seductive dominance of percept over concept. This is power. Once he learns such basic operations of classifying, ordering, logically multiplying, inferring, and so on, he has a strong structural framework from which all of his subsequent knowing can evolve. This, again, is power! Here we are building cognitive structures that can serve as wellsprings of improved and more complex structures in the future.*
>
> *In general it is suggested, the goal of education should be to cause intellectual growth to occur, not merely to teach children the facts, rules, procedures, conventions, and nomenclature of narrow knowledge.*

What are the components of this intellectual growth? Those operations listed above, of course, and more generally, an ability to organize, to coordinate, to pull into coherence the disparate entities of environment, experience, and inference *and to regulate between one's internal networks and the demands of external reality. In classroom situations this would call for children to be involved in issues which generate an ability to discern relevant from irrelevant; to distinguish between necessary and plausible and merely possible; to generate, to exhaust, to test and to cancel alternatives; to know, given a situation, what are the necessary conditions, what are the sufficient conditions, and what is the difference between necessary and sufficient; to solve problems and to generate new ones, and to inquire and to become self-sustaining in that inquiry.*

> *"The main work of the school is surely the fostering and developing of mental life, enabling children to experience more fully and consciously all that life has to offer. This large, overall aim is to be achieved by an infinity of small steps The material we provide children can seldom be thought of as an end in itself but rather as a means through which effective thinking and feeling are fostered."*[5]

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* This paper was commissioned by the Basic Skills Project of the National Institute of Education; it is soon to appear in a collection of NIE Basic Skills papers.

Two By Two

Helen Miller

This is a game for two (2) people to play. It is a game for all ages and all intellects.

Each person is given five (5) blocks or beads or any objects that a teacher may have ten (10) or more of.

Some sort of obstacle is placed between the two players. This may be a book, a block, a box, etc. The object of the obstacle is to prevent either person from looking at the other partner's work.

The first player constructs something with his blocks or beads (in kindergarten I used some large wooden, cylindrical shaped beads, each a different color. This was advantageous because it necessitated use of color words, identification of colors, use and knowledge of the word "cylindrical" and "square" and "cube".)

When the first player is finished with his construction, he must then describe to the second player exactly what he has done in order for the second player to duplicate the first player's construction.

Neither player may look at the other's construction until the describing player has completed his turn.

At the kindergarten level, I found this activity an excellent means of identifying any child having problems with colors or shapes and relationships.

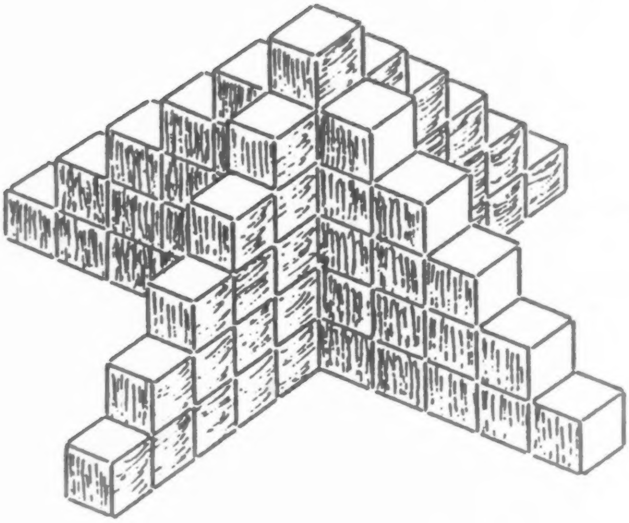
This is an exercise in verbalizing, listening, creativity, vocabulary development, and social development.

I found it to be a good diagnostic tool -- the children found it to be lots of fun!

MATHEMATICAL ACTIVITIES FROM POLAND*

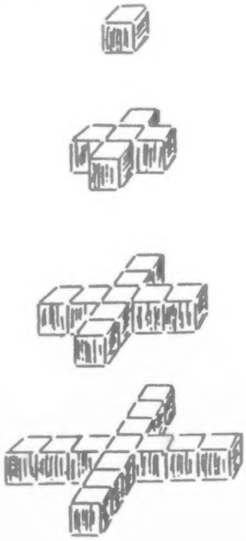
Jerzy Cwirko-Godycki

TV - TOWER



How many cubes do you need to build this tower ?

HOW MANY CUBES HAS THE GROUND-FLOOR WHEN THE TOWER HAS 6, 7,... 10,... FLOORS ?



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*This activity was excerpted from MATHEMATICAL ACTIVITIES FROM POLAND by Jerzy Cwirko-Godycki. The book of activities, a recent publication of the Teachers' Center Project, resulted from the Teachers' Center Project's Summer 1979 course. It is available at cost of printing, $1.00.

Close Encounters of the Math Kind

Susan Dawson

The following paper was written by Susan Dawson, an SIUE undergraduate, who is preparing to become a teacher. Susan was a student in ELED 415, Teaching Math in the Elementary School which was team-taught by T.C. O'Brien and Shirley Casey during Fall 1979. Several short papers were assigned in the course - among them the review of a chapter in a math text.

The article which follows said too much to be returned to Susan unshared. She has given us permission to reprint it in SEEDBED. We have not listed the title of the book; perhaps some of the issues raised herein are appropriate to consider as you think about the textbook(s) you are using.

I have to be honest with you, I have put this assignment off and off and off! It wasn't that I didn't have a math text or hadn't studied a chapter, because I had. So why was I putting it off? I thought on it for a long time and then went to observe a sixth grade teacher who was introducing the chapter. After observing for about twenty minutes, I noticed something very strange. Absolutely nothing was happening. I mean no squiggling in chairs, no ruffling of papers, not even a pencil dropped! The class was in a state of hibernation. Then it dawned on me, who cares about the area of a rectangle? Obviously the kids were bored to death and perhaps that is why I procrastinated so long.

As I thumbed through chapter nine, "Perimeter and Area of a Rectangle," I actually felt nauseated. I couldn't believe that after eight years, since I was in the sixth grade, the approach to a concept could remain exactly the same. I didn't dare think that some person somewhere said this is how we teach perimeter and area, and that was it, everyone accepted it. Oh, the book didn't fool me with its Star War, Big Mac, and Disco graphics. All the graphics in the world will not cover for a nonexistent stimulus. Stimulus? I was informed by one of my co-teachers in the field experience: "To hell with a stimulus! We are teaching kids who need to get back to basics, they don't need our pampering stimulus, they need a strong discipline. They have to learn the basics!"

According to Berkowitz and Rothman (1967), teachers fall into the "child has to learn this..." syndrome. What teachers overlook is that this has little value unless the child himself is convinced that he "needs" this information. Thus, teaching should never be based on "have to", but on "how to". Also, according to Eric Lunzer, "children are naturally curious and are eager to find things out." If this statement has any truth (and I tend to believe it does), shouldn't we attempt to exploit this curiosity.

Looking at this chapter, I see nice neat little questions for me to answer; one, two, three, what will the answer be? A or B. Give me a child who is just dying to know the area of rectangle STWZ, and I'll show you a child who needs this knowledge for himself. Why? Well, maybe he's covering a poster with baseball cards and needs to know how many baseball cards he will need. Ah, area becomes important in the child's world. Child's world? Children will learn what is necessary to them. This reminds me of a Herb Ginsburg article which suggests that schools do not acknowledge children's intuition or construction of knowledge.

The first and only objective I could single out expressed changing dimension within perimeter and area. I don't know, maybe it is me, but when I see those little grids and directions in the book to draw on them, I could scream. Come on, I've never had a textbook in grade school that I could write in. The book tells me to draw a rectangle that has a height of three units and a perimeter of fourteen units. Alright, I'll buy that, but please teacher, give me some grid paper and let me do it myself. I get lost following along in my book with my finger.

In summary, the chapter stunk. Fine, let's burn all math books. No, but what I do wish to express is the importance of teacher awareness. Teacher, you are essential to the future of our children. Has anyone told you there are thousands of new, creative, fun methods to stimulate the teaching of math? If not, please wake up. I could cry when I think back on some of the teachers I have observed. I assure myself that there couldn't be any more teachers around like old Miss A, but I am fooling myself. I'd like to share a conversation I had with old Miss A.

"Oh, hi honey!" "Well, it's that time of year again, fractions." "Let's see, this is my file where I keep everything. Oh, yes, here it is." "What?" "This is my lesson plan, hum, 1952." "Ha, wrote this in '52 and been using it ever since." "I keep all my lesson plans so I don't have to rewrite them each year." "Pay attention, honey, it's a good practice to get into!"

NO THANKS!

Find The Quotation

Bobby Bean and Claretha Robinson

Hidden within these letters are messages. Find each message by crossing out the inappropriate letters.

1. BHIEDTHAVEMUACPDREAM.

   ____

2. ELAMUBEHOLDSEHALTHEMUDTONLYWHASELTNTHINGEENOTGREATERCEMEOTTHANEILT EFTYOURSELF !

   ____

   ____

3. MNOPFIFADMICHARAMRNOTDEMALFORCKMEDCNDETHENAMLTACTWHOMALTMWILLCHARD TSEMEBEELTWANEYFORGEEMEL?

   ____

   ____

4. DEMICHEANEVERCIMSRANEMIBEMYSHELTRAINWOFFETRACKALTHANDCMECRCLANDWH ETIBMELMNEVERANMEMLTLOSTMLMEABIMEPASSENGERCMTAM.

   ____

   ____

5. AZLWECHHOLDEMNTHESEMOPLTRUTHSEQDCTOHCMEBEUIDCAMTSELFMOEVIDENTZNUT HATEMALLHAMENBAAREMLTOCIRCREATEDNTHAMEYEEQUALMOTOLT.

   ____

   ____

Key*

1. "I have a dream." -- Dr. Martin Luther King, Jr.
2. "Behold the only thing greater than yourself."--Mary Bethune
3. "If I am not for me then who will be for me?"--Harriet Tubman
4. "I never ran my train off track and I never lost a passenger."-- Harriet Tubman
5. "We hold these truths to be self-evident, that all men are created equal..."-Declaration of Independence.

Dreidel, Dreidel, Dreidel

Else Sorensen

Teaching fractions, counting, one-to-one correspondence, multiplication -- all of this by using a dreidel? "Dreidel, dreidel, dreidel", is the first line of a Chanukah song which teaches the children as a part of the holiday festivities in December.

One day in December, while I was substituting in the 4/5 year old classroom, some of the children suggested that we play the dreidel game. Cheerios, which were to be eaten by the lucky winner, seemed to be the motivation for playing dreidel.

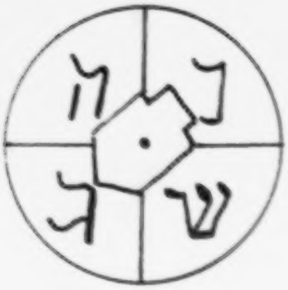
The game was not going too well at first; the "homemade" dreidel was not spinning properly. None of the children knew the rules of the game and seemed to be spending more time eating the Cheerios than playing the game.

So I started over again. I borrowed eight small plastic dreidels from another classroom and I located a book about Chanukah in the library. The book explained the rules of the game.

Mechanics of the Game

The dreidel has a Hebrew letter on each side and according to a book by Ruth Samuels, The Happy Dreidel, the Hebrew letters mean "A great miracle happened here."

The rules of the dreidel game were found in a book entitled Book of Chanukah by Eythe and Sol Scharfstein. The game can be played for nuts, candies, cookies, Cheerios, etc. Any number of players can participate. Only one dreidel is necessary for play.



ה	Hay (take half)
נ	Nun (take nothing)
ג	Gimmel (take all)
ש	Sheen (add one)

The Rules.

1. Everyone starts with the same number of Cheerios.
2. To begin the game, each player contributes one Cheerio into the "kitty".
3. Everyone takes a turn spinning the dreidel.
4. The player does what the dreidel indicates (eg. dreidel as shown above directs the player to "take all".)
5. Play continues until one player has all of the Cheerios.

After having learned the mechanics of the game, we began with five players with four Cheerios each. During the game Jamie spun the dreidel, which indicated hay. This meant he was to take half of the "kitty". (The kitty had 10 Cheerios). I asked him if he knew what "half" was. After giving it some thought, he answered, "Five". I was impressed. After playing for awhile, other children discovered other halves. (Half of six is three; half of four is two). The situation of half of five occured. Bianca took three Cheerios. Why not?

I cut a Cheerio in half to show the children how two halves make one. Then I showed them how 2 and 1/2 Cheerios twice made five; the 4/5 year olds could not understand this.

The children took turns at the "game table" all morning. I delighted in observing them discover "math" while playing the dreidel game. I would like to think their eagerness and motivation were prompted by something other than the Cheerios.

Other Questions To Ask The Children

1. If there are five children with four Cheerios each, how many Cheerios should be counted from the box? Depending on the age of the children, the number of Cheerios could be counted one by one from box or the number of players times the number of Cheerios (5 x 4) could provide the answer.. Other questions which might be asked are: What if you have four players with two Cheerios each? What if you have six players with two Cheerios each? Five players with three Cheerios each? Multiplication Tables!

2. Direct the children to put one Cheerio into the "kitty". How many Cheerios are there in the "kitty"? Counting by ones or multiplying the number of Cheerios times the number of players (5 x 1) can provide the answer. How many Cheerios does each player now have? Counting or subtraction (4 - 1 = 3) can provide the answer. How many do all of us have left? Counting or multiplication (5 x 3) can provide the answer.

Other Activities

These and other similar activities may be found in Ruth Samuel's The Happy Dreidel, Eythe and Sol Scharfstein's Book of Chanukah, and Phyllis and Noel Fiarotta's Pin It, Tack It, Hang It.

The New Trend Is a Search For Excellence

Fred M. Hechinger
The New York Times

In his annual report to the public and the profession, Verne Duncan, the Superintendent for Public Instruction in Oregon, asked the state's educators to make a firm commitment to excellence. A few days later, Dr. Duncan's views were echoed by Dr. Franklin B. Walter, his counterpart in Ohio. The members of Ohio's State Board of Education concurred. And in New Jersey, State Education Commissioner Fred G. Burke recommended the introduction of high school graduation requirements that would include successful completion of four years of English, two years of mathematics, one year of science and two years of history.

A new trend is evident. Excellence and competition are no longer the dirty words they came to be in the 1960's, when requirements and grades smarted under pedagogical as well as ideological attack and were often reduced to a minimum or dropped altogether.

Now, excellence and quality controls are being advocated at education conferences without apologies to those who only recently considered any competitive pressures the mark of a reactionary society. In fact, excellence has not been extolled so unashamedly since John W. Gardner, speaking for the Rockefeller Brothers Study Project in 1958, published an educational exhortation, "The Pursuit of Excellence."

Discussions with school administrators from coast to coast suggest that the new search for quality education differs from the public "back to basics" movement and the nationwide epidemic of minimum competency testing. In private conversation, many administrators express the suspicion that the popular call for a return to the Three R's is more reflective of Proposition 13 tax cutting than of a dedication to educational reform. The "back to basics" appeal is seen by many as a promise of cheaper rather than better schools--cutting out the frills and drilling the pupils in admittedly important but also very limited skills.

The call for excellence, on the other hand, is reminiscent of earlier school reforms that stressed the need for the study of the "hard" subjects, such as literature, history, foreign languages, mathematics and science, instead of "soft" courses, largely introduced in the 60's, that dabble in current sociological theory and "relevant" but intellectually undemanding projects.

A significant straw in the wind of change is the publication this month of Teaching As A Conserving Activity (Delacorte Press, $9.95) by Neil Postman, who was interviewed by Edward B. Fiske in last week's Science Times. Like the school administrators at their unpublicized working conferences, Professor Postman now calls for intellectual rigor and the conservation of lasting values, in contrast to a decade ago when he stood with the radical critics, including such influential names as Edgar Friedenberg, John Holt, Jonathan Kozol and Michael Katz. Their agenda then called for schools to become "training centers for subversion"--subversion not only of the conservative and often stagnant educational establishment but also subversion of most educational and intellectual standards, which students denounced as "irrelevant."

In private conversation, those who are entrusted with the everyday operation of the schools are often bitter about the cavalier abandon with which, they feel, many university-based analysts and critics swing with the trends. Having accused the schools of being too rigid and oppressive, their critics now complain that the schools too readily accept indifferent effort and intellectual mush. The practitioners in the field--teachers, principals, and superintendents--who must always contend with reluctant taxpayers and indifferent politicians speak resentfully about academicians and sociologists who enjoy the luxury of fielding movements and countermovements without the responsibility of translating ideologies and theories into classroom practice and the staying power to stick with their own theories.

Why, then, the current indications of a new agreement between school people and academicians on the need for a return to more rigorous requirements?

The answer seems to come, as it usually does when educational attitudes change, from outside the schools--from new demands emanating from economic and political realities.

Last week, Paul E. Gray, the new president of the Massachusetts Institute of Technology, said: "We have lost a certain edge in technological innovation." He pointed to the decline of American scientific and technological prominence in areas in which the United States had long been the undisputed leader. In recent weeks, representatives of American industry have voiced similar concerns.

Other observers note that many of those who denounced competitive standards in the 60's as the instruments of oppressive capitalism pointed to the theories of Ivan Illich, the radical school reformer, and to Maoist and socialist approaches to noncompetitive group learning as the wave of the future. Yet, China has joined the Soviet Union as a revolutionary society that reintroduced a competitive striving for educational excellence. The return to the pursuit of excellence everywhere, regardless of political ideology, appears simply to acknowledge that, without it, technological societies cannot maintain their economic momentum and social stability.

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[*] This article is reprinted in its entirety from The New York Times, October 16, 1979. Reprinted by permission.

Working As A Group -- At What Age?

Helen Miller

An interesting experiment in the social development of children developed as the result of a math activity. I was trying to teach the children to group objects by shapes.

Each child was given some large wooden beads. Some of the beads were in the shape of cylinders and some were cubes.

The children were seated around tables. There were five tables with five children at each table.

I asked each table to sort the beads into two groups according to their shapes. Only at one table could the children work together to make two piles of beads. All the others could not understand that each child must give up his own beads in order to group them into two piles.

In the class there are children as young as four years of age and as old as six. The table that was able to carry out the assignment had a group of five year olds.

Continuing along these lines, I asked each table to construct one thing using all their blocks. In other words, they had to all work together in order to come up with one construction, necessitating the sharing of each individual's beads.

Here again only one table was able to work together to come up with one idea. This, however, was a different table from the first time. This table also had several of the older children.

As a result of this activity I concluded, as Piaget did, that at the kindergarten level, the children were emerging from the "I" level and just beginning to work at the "we" level, but each child was progressing at his own rate.

Mathematics Ability of Pupils Declines

New Survey Finds Even Simple Problems Defeat Large Numbers of Children

Albert B. Crenshaw
Washington Post Staff Writer

American schoolchildren have grown perceptibly worse over the past five years in their ability to solve relatively simple mathematical problems, according to a survey of mathematics education released today.

Fractions, percentages and word problems of all kinds--even ones as simple as "What is the sum of 54 and 21?"--defeated large numbers of the 9, 13, and 17-year-olds tested, the survey found.

Fewer than half the 13-year-olds and only 13 percent of the 9-year-olds (mostly fourth graders) could determine "What does 2/3 of 9 equal?" (6).

Slightly over a third of the 13-year-olds and a bit over half of the 17-year-olds could "Express 9/100 as a percent" (9%).

Nearly a quarter of the 9-year-olds could not correctly answer " What is the sum of 54 and 21?" although if it were set up for them as 21 + 54, 90 percent could provide the solution (75).

Performance at all three age levels has declined between 1973, when the tests were last given, and 1978 when this set was run, with the falloff sharpest among the older children.

Educators affiliated with the survey pointed to the discrepancy between computational skills and problem-solving and linked it to the "back to basics" trend that has surfaced in education in the interval between the tests.

"I think we should be asking ourselves if we are creating a generation who can compute but who don't know when to compute," said Roy H. Forbes, director of the National Assessment of Educational Progress, which conducted the survey.

What is missing is problem-solving performance," said Dr. Shirley A. Hill of the National Council of Teachers of Mathematics. "Often (the pupils) give answers that are not even reasonable."

Hill, a member of a panel of educators who interpreted the test results, pointed to a question in which the children were asked to figure out how many cars would be required to transport a number of people. Many, she said, gave fractional answers.

Hill charged that there has been "an excessive narrowing" of mathematics teaching. Schools have "been responsive to public pressure" to emphasize computation to the point where the teaching of application has been slighted, she said.

The decline, however, parallels a long-term one that has been recorded in college board aptitude scores. That decline, which began in the mid-1960s, encompasses the old math, the new math, and the back-to basics math and Hill acknowledged that she might be overemphasizing the role of recent curricula.

"One doesn't ever really know the causes", she said, noting that a study of college board scores several years ago cited "multiple factors" that could be responsible for the decline.

The National Assessment of Educational Progress is a long-term, government-sponsored program to try to evaluate how well American children are doing in a variety of subjects. The NAEP runs tests in 10 fields, from reading and writing to science, music and social studies, and reports periodically on its findings. The math tests involved 71,000 children.

"The pattern found in mathematics--larger declines for older children and more of a tendency for declines. . . on higher-order cognitive skills--is very similar to that found by the National Assessment in reading and writing," Forbes said in a prepared statement.

Thus, he said, children are doing well in basic mechanics of a broad range of subjects but fall down when it comes to making use of them.

Forbes and Hill both expressed concern that the "minimum competency" tests now being given in a number of jurisdictions may be, in Hill's words "coming to dominate the curriculum." She said she fears that many schools are gearing their teaching to these tests.

The one bright spot in the results was the performance of 9- and 13-year-old blacks, who showed substantial improvement.

Hill said she believes that "compensatory programs in inner cities are beginning to have an effect."

However, the report noted, "by age 17 favorable trends for blacks were no longer evident."

The report divided its results by race, sex, region of the country, parental education and community size. Findings included that whites do better than Hispanics who do better than blacks, though the younger blacks have been closing the gap somewhat; boys and girls do about the same at 9 and 13, but boys do better at 17; the more education their parents have, the better the children do.

Also, suburbanites do better than big-city dwellers, and "advantaged urban" dwellers do better than rural residents who do better than "disadvantaged urban." Northeastern children do the best, children from the central part of the country next best, westerners next best and southeasterners worst, though the 9-year-olds in the southeast showed the only improvement besides the younger blacks.

This article is reprinted as it appeared in the September 14, 1979 issue of the Washington Post. Reprinted by permission of the Washington Post.

Some Comments On National Assessment Results

Thomas C. O'Brien

The recently released 1978 National Assessment of Educational Progress reports on mathematics achievement suggest that math students (71,000 tested nationwide at ages 9, 13, 17) can handle arithmetic computation pretty well but have difficulty using their skills in solving everyday problems. This finding, and the fact that 1978 findings are lower than those of 1973, have led various commentators to conclude that the Back to Basics movement has produced decent mechanical abilities but not application, conceptual, or thinking abilities. (See commentaries in NAEP Newsletter, Vol XII, No. 5; New York Times, September 25, 1979: Washington Post, September 14, 1979.)

Fair enough. Back to Basics is largely Back to Memory.

The NAEP reports, include more than achievement reports, however, The following 1978 results are reported for the 13 year olds.

Last year in your mathematics courses, how often did you: (often/sometimes/never):

---Listen to the teacher explain a mathematics lesson? (81/16/2)

---Watch the teacher work mathematics problems on the board? (76/21/2)

---Make reports or do projects in mathematics? (4/38/57)

---Work mathematics problems alone? (81/17/1)

---Do mathematics laboratory activities? (2/21/76)

---Choose what mathematics you wanted to study? (3/22/74)

---Use a mathematics textbook? (81/14/5)

Is it any wonder that students do poorly? Perhaps more distressing are the data concerning the use of a calculator. Of 13 year olds, 85 percent never use a calculator in math classes (94 percent said "never" for science classes), yet 73 percent report the use of a calculator in their home activities.

So there are two problems. What clearly is needed is for teachers to move Forward to Basics, not backward to static stuff. And despite all that's known about children's learning, we still seem to act as though knowing were a spectator sport.

Mathematics is the construction, testing and application of relationships, not a storehouse of inert facts and procedures. Today's children will live most of their lives in the Twenty-First Century. Should we retreat, in goals and approaches to learning, to the Nineteenth Century?

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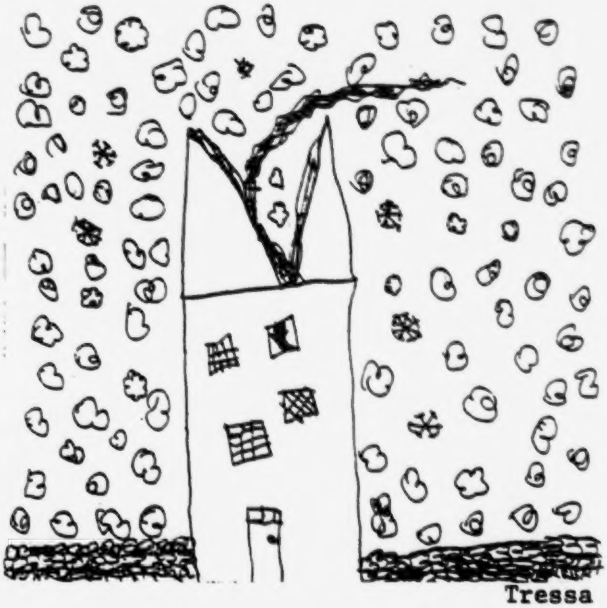
*This article was prepared at the request of the ASCD Monthly Newsletter. It appeared in the February 1980 issue



Tressa

Quotable

Bobby Bean

The letters in each vertical column go into the squares directly over them, but not necessarily in the order they are placed in the columns. The black squares indicate the end of a word. When the letters are placed in their correct squares, you will find a famous Black quotation.

■	■					■	■			■	■	■					■	■	■
				■	■	■			■	■	■					■	■		
			■	■				■	■	■									■
■	■			■	■	■					■	■			■				
A F	R N	I E F K	E M R	E	G E	O	F D A	R A T	T E	E	A	L L	A A L M	A I S T	G S T	I H T	A T	S T Y	T H

■	■		■	■							■	■	■					■	■
	■	■	■						■	■	■						■	■	■
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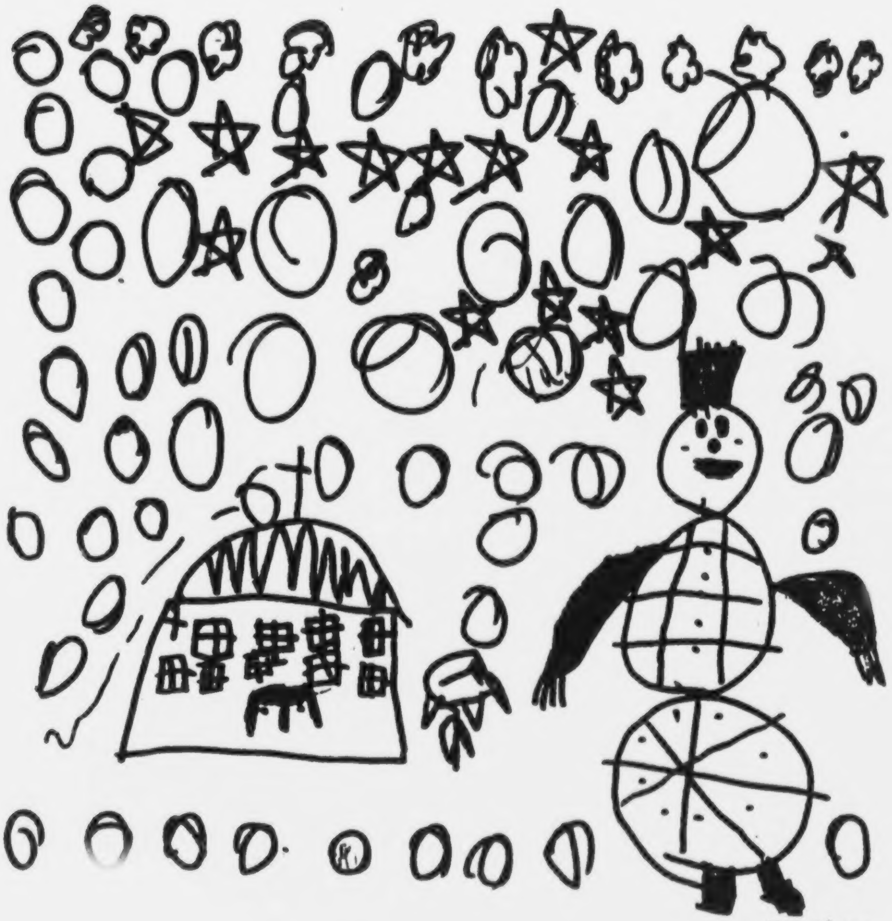
■	■	■				■	■	■		■	■	■	■						
■	■				■	■					■	■			■		■	■	
				■			■	■				■	■						
A C H	A I	A N N W	B G H	G O U	I P R T	D E E S	C E O R	A N S	A A N O	A L N T	L N	T Y	D H T	H O P T U W	E I I H M	A B N R T U	G H M S	B O	N S T

Answers: "Free at last. Thank God Almighty, I'm free at last!" "A person with a green thumb can do anything. But a person who can't do a thing is all thumbs."



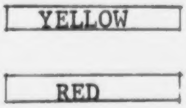
Heather

Conservation of Length

Sue Modro and Joyce Mathes

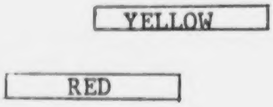
A problem involving conservation of length was presented to 84 children, grades 4, 5, 6 at one school, School A, and grade 5 of another school, School B.

Both of the schools are in the Belleville area, and both schools are considered to be socio-economically deprived schools since both schools participate in the Title I program.



The rulers were placed one under another. The first question was then asked, "Are these two rulers the same length?" If the answer was no, they were asked, "which was the longest?"

Then the red ruler was moved six inches to the left.



Again the children were asked, "Are they the same length now?" If they responded no they were asked, "Which is longer?"

On the next page you will find the results of this test.

It would appear from our test that this concept develops at the 5th grade, approximately 10 years of age.

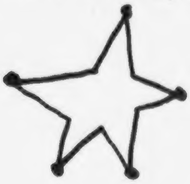
According to Kenneth Lovell's transcript "Implication of Piagetian Research for Education" this concept should develop at age seven to eight.

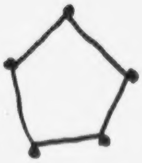
FIRST QUESTION Are these rulers the same length? If not, which is longer?	SECOND QUESTION Having moved one ruler to the left, "Are the rulers the same length now?" If not, "Which is longer?"	Gr. 4 School A	Gr. 5 School		Gr. 6 School A	TOTAL
			A	B		
YES	YES	3	15	8	19	45
YES	NO--Red	6	0	0	3	9
YES	NO-Yellow	4	6	0	0	10
NO-Red	NO-Red	2	1	1	0	4
NO-Red	NO-Yellow	3	1	2	1	7
NO-Yellow	NO-Yellow	1	1	0	1	3
NO-Yellow	NO-Red	3	1	1	1	6
TOTALS		22	25	12	25	84

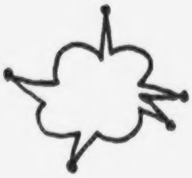
Zips, Hoops, Pops, Boops, Etc.

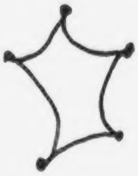
By the East St. Louis Bunch*

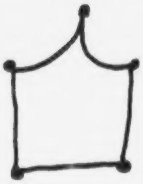
These are Zips



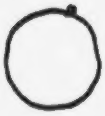


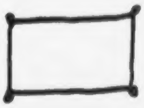


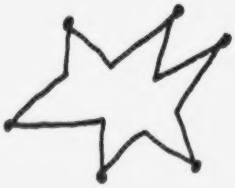


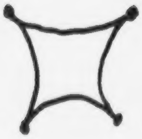


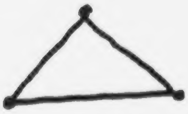
None of these are Zips.



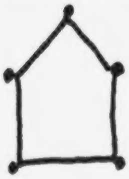




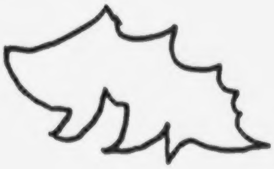




Which ones are Zips?



A



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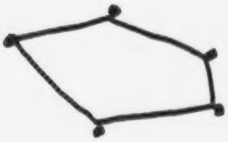

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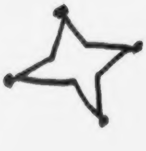

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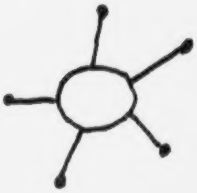

E

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* The East St. Louis Bunch includes Bobby Bean, Norma Crowell, Rosie Fisher, Wallace King, Lillie Mixon, Claretha Robinson, Elizabeth Thomas, and Diann Williams.

These are Doodly Goops

96 195 348 636 3723

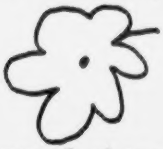
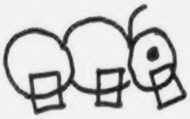
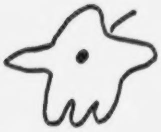
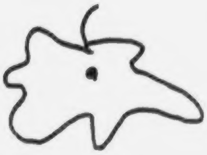
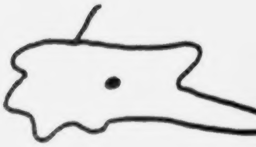
These are not Doodly Goops.

57 101 325 643 3071 3 15

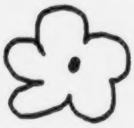
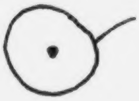
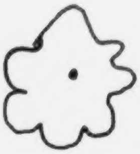
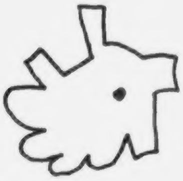
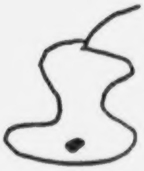
Which ones are Doodly Goops?

471	375	430	708	276	344	555
A	B	C	D	E	F	G

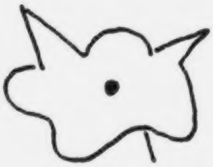
These are Pops

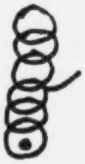






None of these are Pops.

Which ones are Pops?


A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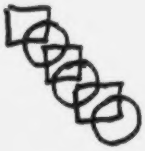
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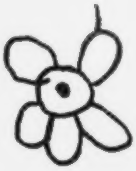
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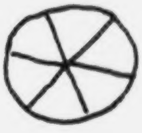

E

These are Boops.

96 120 960 424 16

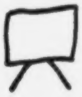
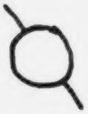
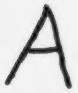
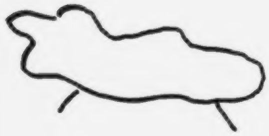
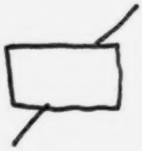
None of these are Boops

7 3 91 150 75

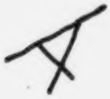
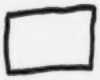
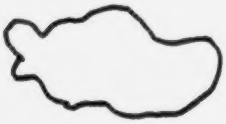
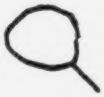
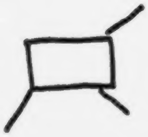
Which of these are Boops?

24	19	40	46	78
A	B	C	D	E

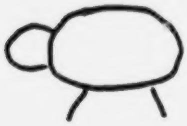
These are Hoops.

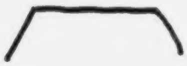
None of these are Hoops.

Which ones are Hoops?



A



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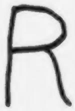

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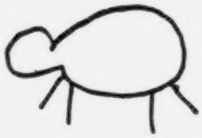

D

These are Doodly Woops.

86 185 275 617 2435

None of these are Doodly Woops.

74 202 315 542 2071 7

Which of these are Doodly Woops?

95	77	356	84	39	78
A	B	C	D	E	F

These are Miggly Loops.

69 18 171 315 633

None of these are Miggly Loops.

44 19 284 403 845

Which are Miggly Loops?

86	21	116	66	71	81
A	B	C	D	E	F

Answer Key.

Zips are figures with five points. Answer: A, C, & E.

The sum of the digits of a Doodly Goop is 15. Answer: B, D, E, & G?

Pops are figures with 6 parts, a dot and a tail. Answer: A, B, & D.

Boops are divisible by 4. Answer: A & C.

Hoops are figures with 2 legs. Answer: A, B, & C.

Doodly Woops are numbers whose digits add up to 14. Answer: A, B, & C.

Miggy Loops are numbers that are divisible by 3. Answer: B, D, & F.

Hoops are figures with two legs. Answer: A, B, & C.

Scatterers

Burton Albert, Jr.
The New York Times
New York, New York

Diane Anthony
Maplewood School
Cahokia, Illinois

Irene Armbruster
Southern Illinois University
Edwardsville, Illinois

Anne Bailey
Southern Illinois University
Edwardsville, Illinois

Bobby Bean
Park School
East St. Louis, Illinois

Gloria Blaes
Southern Illinois University
Edwardsville, Illinois

Mary Blair
Milton School
Alton, Illinois

Albert Crenshaw
Washington Post
Washington, D.C.

Norma Crowell
Rock Junior High School
East St. Louis, Illinois

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SEEDBED

Number 5

May, 1980

Teachers' Center Project
Southern Illinois University
at Edwardsville

INTRODUCTION TO SEEDBED

It was John Bates. And Peter Wason. And Eric Lunzer and Terry and Elizabeth Dolan.

Our winter 79-80 Teachers' Center sessions were largely given to language and thought in children, rather than to mathematics and thought as has usually been our interest.

It was John Bates who started it off. In November John did a two day seminar (during the school day; some thirty teachers took part, many at substantial personal cost) on language and communication in elementary school children. The seminar was a smashing success and off to the races were the participants and the many fellow teachers with whom they shared their ideas.

And Peter Wason and Eric Lunzer and the Dolans were major contributors as well. Peter brought to our attention some research he had done on collaborative writing when he visited here in 1974 and Eric and the Dolans had done spadework on applications of the Cloze technique to intellectual growth (not to testing, its usual application), a fact that Eric mentioned when he was here in 1976.

Our last three months at the three Teachers' Centers have been concerned with collaborative writing and group Cloze.

By collaborative writing we mean simply this: Two or more people write a story, usually but not necessarily beginning with, "Once upon a time . . ." The goal is to construct as coherent story as possible. One person writes a sentence, then passes it to the next person with no oral communication. The second person adds a sentence and passes it on to the next person. The story stops when everyone is satisfied. Then a group editing takes place and the story is ready for sharing. (In some cases, the authors turned their enterprise into a book, graphics and covers and all.) Our collaborative story writing started with teachers (What wonderful stories we wrote!) and traveled from classroom to classroom all over the area. Even grade K and grade 1 children took part with teachers doing the recording.

Group Cloze was as simple as this: Stories were taken from the available literature -- it's important that the stories be appropriate for the participants in terms of interest -- and typed up with every tenth work left blank. We first, and then our children, worked in groups of three or four to argue out the best fill-in for each blank. There is usually no one right answer; in fact diversity of responses is virtually unavoidable. But it's not the response that's the payoff. It's the argument (in the best sense of the word) that makes the issue worthwhile. Think of the richness of argument -- involving semantics and syntax, to say nothing of spelling and other such "basics" in working out the Cloze stories on pages 31 and 36.

Although this SEEDBED is largely concerned with language, we have not neglected our usual issues. Part 2 of SEEDBED is concerned with the usual mathematics and intellectual development issues that has so fruitfully occupied us so long.

And we are delighted to include a third section, written by our visiting scholar, Jerzy Cwirko-Godycki, presaging his new Teachers' Center book.

Read, but more important, do this SEEDBED. Perhaps you'll get a feeling for the potency of teachers. And kids. Join us in the view that Knowledge is not a spectator sport.

May, 1980
University City, Mo.

Thomas C. O'Brien

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Collaborative

Writing

Collaborative Writing

This is where it began. We teachers constructed collaborative stories, some of which are reported below.

Once upon a time during a difficult time in a nine year old boy's life, he decided to take over his own schooling. At least he thought so. The big problem was how to get to read his comics during school without his teacher knowing. Being a humanistic sort, which he had not yet discovered, she would not have cared. So he began to devise elaborate plans for concealing his treasured reading. Most notably, he constructed a folded screen around his table with pockets on the inside for comics and he convinced the other children to give the teacher a birthday present -- squeaky shoes. Fortunately for everyone concerned he became interested in a girl. Girl-watching was almost as much fun as reading comics.
--Else Sorensen and Mary Steffen

Once upon a time there was a little boy who had a slight physical handicap. In the beginning this physical impairment kept him from participating in physical activities. Every morning when he got up he said, "Mother, do I have to go to school today?" His mother said, "I will not force you to attend school, but life can be very empty without friends." He replied, "Mother I don't have any friends." Mother said, "Friends do not come without some expense." Mother reminded him that before he could have a friend he must first be a friend. As the years went by, he practiced his mother's advice and not only found friends but improved his physical condition as well. --Ruby Mack and Bill Breden

Once upon a time in a land where women were the dominant figures, a great conflict arose over the equality of men and women. The men were constantly at war among themselves trying to overcome their inequality and to become at least equal or dominant figures. They were tired and frustrated with their positions as housekeepers, cooks, and child-rearers. Their lives lacked meaning. They finally reached a conclusion: they would assassinate all the women over 15 years old and raise the young to suit their own lifestyles. -- Theresa Ryan and Ruby Mack

Once upon a time there was a very large fat king. The king was a very jolly fellow. In fact, everyone in this land was very jolly. The reason that they were jolly was the fact that they had a river of beer that flowed through the town.

For this reason everyone had an enormous craving for pretzels. One day the AA came to town. They had moved up the river from drunken town to drunken town trying to cut down on the over-use of the river. In the jolly fat king's town the AA convinced the populace that water was better than beer. The entire town quit using the river and began using water instead. The king grew sad and the pretzel factory was near to bankruptcy. The king gave government aid to the factory to try to give the pretzel twisters their jobs back.

One day the AA got stuck in the middle of the river on the refuse of the unused dumped pretzels. Realizing the dilemma they had caused by abolishing the use of beer, the AA decided to undo their work in the town. The only trouble was they were stuck so they began to swim to shore gulping beer because they were such poor swimmers. When arriving to shore AA was very jolly and the whole town saw that even AA could be rehabilitated. --Katy Murray and Donna Johann

Once upon a time a dog ran down the street very fast. He ran so fast because he was chasing a cat. A blue car was racing around the corner right behind the dog. The car got closer and closer and ran over the dog. I ran outside and picked the dog up from the street and carried him into my house. Its big sad brown eyes looked up at me. My dad was in the garage and he heard me call for someone to help me with the dog. At that point the dog got up and said, "Smile. I'm not hurt." I hugged him, I was so happy he was fine. --Sally Stumpe and Liz Anderson

Once upon a time a lovely princess lived in a big castle. She was very happy because she could do anything she wanted to do. One day, while playing in the garden near the castle, she saw a butterfly and screamed, "I want it, I want it!", but the butterfly kept on flying. The princess decided that instead of capturing it she would just sit and watch it. Suddenly the butterfly hesitated, flew toward her and finally settled down on her hand. She looked for a moment, raised her other hand and smashed the butterfly. It was dead, flat, and broken. What a wicked little princess. --Else Sorensen and Helen Miller

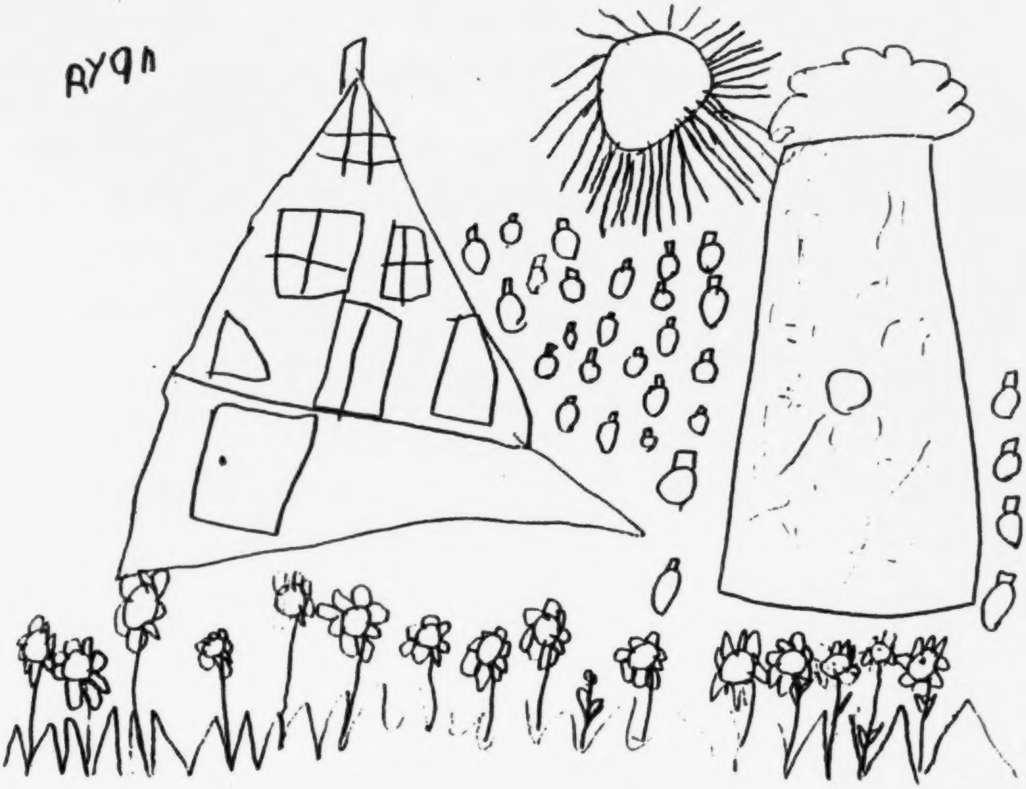
Today was a very busy day on our playground. You can't imagine all the uproar that took place! Children were confused and bewildered because of not enough communication with people in power. They couldn't believe their ears when they heard the principal on the intercom so early in the morning. Roar! "Do you care nothing for equipment that we have furnished you?" "I want all the 4th, 5th and 6th grade children to meet at 10:30 in the corner of the playground by Miss June's room. All repented in sad looks and agreed to do much better from now on. --Eva Weldon and Lois Daesch

Once upon a time in the age of cavemen there lived a wise man named Crete. Crete loved to read but in cavemen time there were few books. So Crete decided to make a book of his own. Crete thought about a title for his book; it was to be titled "The Things I See Around Me". He looked around and the first thing he saw was a huge bird flying overhead, so he carved a picture of the bird into a cave rock. Then he looked around to see what else he could find to write about in his book. As time passed Crete covered the walls with pictures and then delighted in the many interesting things that he had drawn. The last picture on the wall of the cave was a Brontosaurus chasing a man. Wonder what happened to Crete? --Jewel Birge and Billie Johnson

Once upon a time, there was a little old lady. She was 84 years old. She was so tired. She had lived such a long time. She had a great idea about seeing the world. She saved up her money and went to her travel agent. She asked her agent about many cities in South America. He said, "Venezuela is very pretty and Caracas is one of the nearest South American cities you can visit." "What! Why can't I visit Brazil; I have heard so many good things about it," the old lady said. "Okay," said the travel agent, who was her son and who was able to provide free airline tickets for his family. He wrote up a ticket for Rio and away she went!
--Willa Orr and T.C. O'Brien

A new place has just opened up near the town where I teach. There is much talk about the main attraction of this establishment. There was an ad in the newspaper for "help wanted" at this place. Needless to say, I did not apply! There was one reason why I vetoed the application. My bumps were not bumpy in the correct places. "The Lord giveth and the Lord taketh away" - Gal. 4:6. So I suppose I'll just have to stick to school teaching. The only thing that could possibly make me apply would be the health insurance package offered and the tips. Some of the patrons were wondering what they use for swizzle sticks. Of course the place is Happy Joe's, the new pizza parlor. It sounds like a fun place to work.
--Fred Habermehl and Carol Ann Seibel and Friend

In winter we have lots of fun. We do different things with snow on the ground. We make snowmen and snowforts. We always end up hitting each other with snowballs after we have made our snow sculpture. Then mother calls us in for some hot chocolate and cookies. We sure enjoy sitting around the table talking about all of the things that happened while we were outside playing together. Then we go sit by the fire, watch television, or play a game of Scrabble. We have lots of fun thinking up words. Mother says this is good for our mind. It's nice to have such neat friends to share good times with. --Lorraine Allison and Kathie VanKuiken



Samples of Making up Stories after Looking at Pictures

Elizabeth Anderson

After two or three Teachers' Center sessions in which we wrote stories collaboratively, edited them, and shared them, we had a pretty good feel for the issue. Our next step was to try things out with children. Here's a first step with pre-schoolers. These stories were not written collaboratively; rather children told their stories individually to Liz Anderson, who recorded the stories and passed them along to us.

That is a picture of a brother and sister picking flowers. They will bring them home and put them in something that will keep them standing up. Their mom would say "They are pretty." Christine, age 4

Here is a cow with another cow at the farm. The rooster would go "Cock-a-doodle-doo". At the farm the animals eat their dinner, watch TV, and sit down. Boys and girls ride the horses on the farm. They need a horsey seat to ride on them, though. Jessica, age 4

On a bush there were blueberries. You pick them, rinse them off, and eat them. The ones that you don't eat you leave for the birds. Heather, age 3

The kitty went for a walk. He went to the store to get some stuff to get the tangles out of his fur. Carrie, age 4

Once upon a time there lived a grasshopper. He lived there in the grass with his mother and father. He jumped in the dirty lake. Then an alligator came. The grasshopper went to the bottom and jumped as far as he could and landed on the shore. His mother and father came. The end. Jason, age 5

Once upon a time this kitty went to the grocery and got his food. His money he stucked in his fur. He ate the food all up. The bad wolf came and he told mom to get dad and shoot the wolf. Carrie, age 3

Once upon a time the cat went outside. He climbed up the tree. He got down and got chased by a dog. "Ruff, ruff. Meow" Usually he got caught. A dog bit the cat's tail. He scratched at him. Finally the cat bit him. James, age 5

This bird went out one day looking for food. He came to a house that was all locked up. He shrank himself down so he could go in the door lock. He took the food home and ate it all up. Jason, age 5

Some Comments on the Value of Collaborative Writing

Claretha Robinson   Billie Johnson
Elizabeth Thomas   Willa Orr

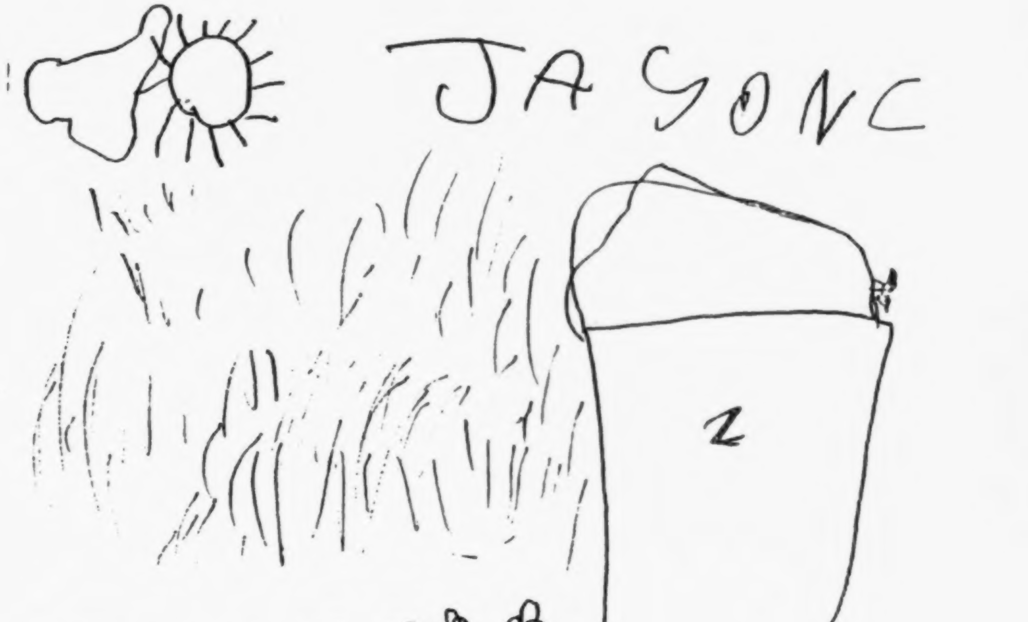
After we tried out some collaborative writing, both among ourselves and with our classes, we agreed that group writing has the following payoffs. There are probably other benefits which teachers can add to our list.

1. Vocabulary is increased because one picks up new words from the other person.
2. One gets richer ideas when he listens to the other fellow and builds on what that person has said.
3. Children learn to use complex syntax.
4. Collaborative writing gives a realistic situation where proofreading skills are important.
5. Children get a sense of sharing, or mutual construction, as a story unfolds.
6. Children are often surprised and delighted at the turns the stories take as the writers alternate.
7. It's easier for a child to write when the burden is shared.
8. Ideas seem to flow really freely when the stories get going.
9. Children become authors, not the readers of other people's stuff.
10. Collaborative writing helps children to learn to respect the ideas of others.
11. The criteria for a good story is not some pre-set rule; there's no right or wrong; the criterion is the children's judgment of the coherence of a story.

12. Children learn a lot about the logical and temporal flow of events in a story.

Warning to teachers: Don't expect magical results the first time out. If the issue is a trivial one--learn that Phoenix is the capital of Arizona, that comes quickly--but if the issue is an important one, learn to be patient. It works.

Editor's Note: In his April, 1980 Teachers' Center seminar, John Bates said that a story which has a guaranteed audience is likely to be vastly better than one which doesn't. Perhaps the guaranteed readership intrinsic to collaborative writing is an important ingredient in its success.



Why Collaborative Writing (in First Grade)?

Dianne Anthony
Nellie Rush

The pressure is on for students to do quality writing. Our research shows that collaborative writing is an excellent tool to employ. Why? Because the focus is on enjoyment and satisfaction rather than grammatical skills. Correct grammar is of great importance, but does not take priority over the act of writing. Proofreading for grammar and punctuation is an important skill which follows as children polish their stories.

Collaborative writing motivates children to think, enhances concentration, develops thinking, expands the imagination and promotes discovery of things a single writer might not think of when writing alone.

Collaborative writing is valuable in providing children the freedom to express thoughts and ideas. As important, children see differences in opinions--put themselves in the other guy's shoes--and then discuss the alternatives. Discussion and collaboration help to develop story sequence and logical flow.

Collaborative writing is an invaluable activity for slow learners because these activities provide meaningful experiences. The stories come from the children. Because of this, and because ideas are shared and extended, children gain self-confidence and perseverance.

Why Creative Writing (in First Grade)?

Dianne Anthony
Nellie Rush

Teachers sometimes are hesitant when it comes to involving first graders in creative writing because they feel that first graders are too young and too immature to put their thoughts and ideas into stories. However this is true of some first graders, it is not true of them all. It has been our experience that some first graders can become very good story writers.

In considering creative writing in first grade, one must consider one's objectives. The first consideration of any writing experience is to encourage children to write because they want to write and enjoy it. Second, the writing should be meaningful to the children. Third, skills can be developed. (Reading skills are developed through the reading of stories. Stories can be shared and read again and again. Not only are spelling skills developed through the sounding out of words, dictionaries and books, but language skills and writing skills are developed also.)

Another point needs to be considered. What can creative writing do for the slow learner? Our experience makes it clear that creative writing can develop skills, self-confidence and a feeling of success. (Slow learners may not be capable of writing their own story, but they can dictate stories to the teacher.) The children then learn how to read their stories and share them with others. In time they too learn to write their own story. They are often very successful.

Collaborative Writing

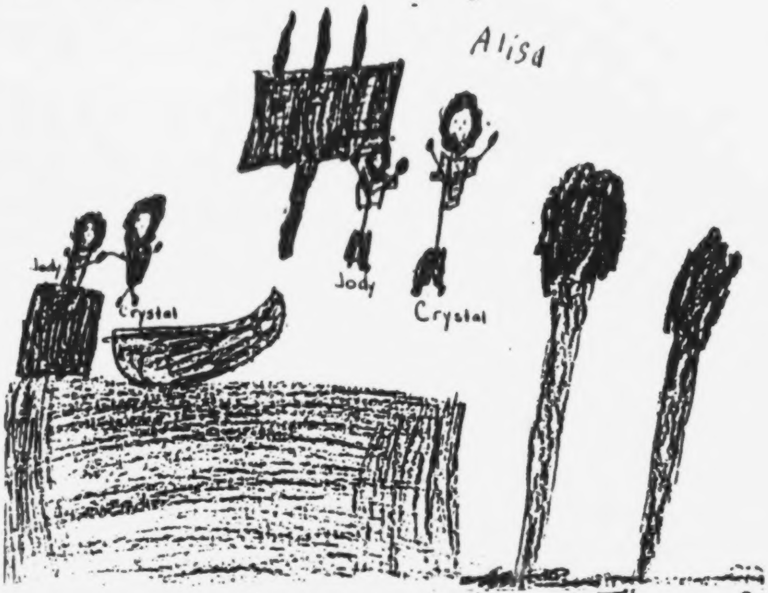
Dianne Anthony

Here's an example of collaborative writing--in fact, the project evolved into a book--done by first grade children in Dianne Anthony's class *Maplewood School, Cahokia*

Our Story

Once upon a time there was a little girl and boy. Their names were Crystal and Jody They didn't have anything to do. They went to school everyday. Crystal and Jody

lived in a castle. They had lots of money and pets. Their castle was in a forest. The forest was filled with green grass and trees. When Crystal and Jody got home from school, they took a walk in the forest. Jody got lost. Wild animals were chasing Jody down the path by the stream. Jody fell into quicksand. Crystal followed Jody's tracks and found him in



the quicksand. Then Crystal took a long pointed stick and helped Jody out of the quicksand. Then they went back home.

— The End —

Dianne Anthony
Grade 1
(entire Class)

A Starting Point

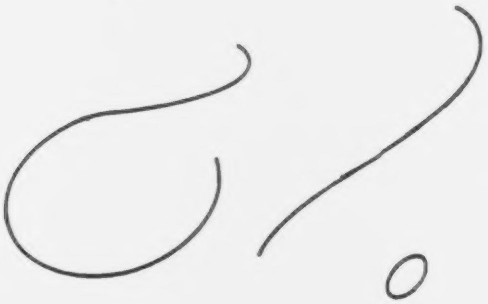
Dianne Anthony
Nellie Rush

We placed blobs of paint, such as fingerpaint or tempera on sheets of paper in combinations of curves, lines, figures, etc. With these, children can create their own pictures. Crayons or marking pens can be used to add features or things like feet and arms.

After the pictures are completed, they should be given titles. The children should tell as much as they can about their pictures.

Next, each student is to write his/her own story about the picture.

Here's a curve (to be completed by the children) which was used successfully.



Make a picture
Color the picture
Write a story about
the picture.

Collaborative Writing

Lillie Mixon

These stories are from Grade 3 children, Slade School, East St. Louis.

One Saturday evening the phone rang, and a man told me I was chosen to be on "The Price Is Right." I said, "Mom! Dad! A man just called and said I was chosen to be on 'The Price Is Right'. I will be on TV at 7:00 on channel four." Mom and Dad were proud of me. I told my brother and sister about it. I went to the show and the man asked me how much was the Datsun car. I said it was $1,082.00. He said, "You win the car." I started to jump up and down. I ran on the stage and thanked the man. That ends the story. - Jeanette and Delisa

One day I was quietly watching t.v. when all of a sudden I heard a strange noise at the door. I went to see what it was. It was a baby kitten, wet and hungry. I felt sorry for her, and said, "Poor baby, come in and get some milk." Meanwhile mom came into the kitchen and I told her what happened. I begged her to let me keep her. She said ok, if I promised to care for her. I promised her and that's all folks.
- Angela Y. Wilson and Denitra N. Rivers

One hot summer day, Herb Humphrey came on TV and said, "Alice the elephant had escaped from the zoo." She was on my street. I saw her crunching and crashing down houses. "Ma! Ma! A elephant is coming by our house." He crashed it down. The boy said now you asked for it. Boom! Crash! Boom! Crash! Then we called the zoo keeper. The zoo keeper drove up in his car and shot Alice down in cold blood. And that was the end of Alice. - Dawne Dunlap and Tommy Simon

Once upon a time there was a little boy and girl. Their names were Jody and Crystal. They didn't have anything to do. They went to school every day. Crystal and Jody lived in a castle. They had lots of money and pets. Their castle was in a forest. The forest was filled with green grass and trees. When Crystal and Jody got home from school, they took a walk in the forest. Jody got lost. Wild animals were chasing Jody down the path by the stream. Jody fell into a quicksand. Crystal followed Jody's tracks and found him in the quicksand. Then Crystal took a long pointed stick and helped Jody out of the quicksand. Then they went back home. - Jason and Alisa

Once upon a time there were lots of frogs. They splashed water all day. The frogs got out of the water and played all day. After they played all day they went to sleep. That night they came out and danced all night. In the morning they went looking for food. They started to play and jump and danced all day. - Carmen Gayden and Tavana

Once upon a time, there were four little monkeys. They spit and smiled at the other animals in the zoo. They looked and swung on the bars and the other animals were awakened because the monkeys were swinging. All night long the other animals were mad at them because they would not stop. But one night the keeper left the cage door open and the monkeys got out. The zoo keeper had a hard time getting them into the cage. Then the monkeys went to sleep. The next morning the keeper gave them a banana. When they got through they wanted more bananas. - Tammie and Ohala

Diary of a Student
4th Grade

Ruby Mack

I have had Joey (a pseudonym) in my classroom since school began in August. He never wanted to participate in any classroom activities. He did only the assigned work. He is an average student.

January 22

Today we wrote our first story with a partner. Each student contributed a sentence, then passed the paper back and forth until the story was finished. Joey would not accept a partner. After the other students began to write with their partners, I wrote the first line of a story and laid it on his desk and together, he and I wrote the following story.

> *Once upon a time there was a small monkey who lived in the jungle. That little brown monkey was named Cheta. When she was very young her mother was killed by a hunter. Cheta was very scared of the jungle. She wondered what would happen to her. She saw some bananas but she couldn't reach so she tried to climb the tree but she couldn't when a lion came along she climbed a tree with a lot of branches but she still couldn't reach then jumped and missed she tried again and she made it. As she sat on the ground eating her bananas another monkey came along and stole some of her food. She went along down a trail. She saw something good started to hear drums she went on further and before you know it was in a trap that the head-hunters had made. Now she was really frightened and wondered is she was going to die. They took her out of the trap. She was frightened. She fell asleep next couple of hours. She woke up with headhunters around her. They started feeding her the food. She smelled a soup and some bananas with it. Some of the children in the village began to shout, Look at the cute monkey. I want her! I want her! The kids in the village got to playing with the cute monkey. She never had to go without food or friends again. Finally the head-hunters let the monkey go back in the jungle with a lot of bananas. The End.*

January 23

Joey would not participate in the classroom activity.

January 24

He did not participate in the classroom activity. However, he did not turn his chair to the wall during our reading group.

January 25

Joey was absent.

January 28

Today he joined his reading group but there was no oral participation. We wrote another story. He would not accept a partner assigned to him, nor would he choose a partner. After the other students began to write, Joey wrote the first line to a story, laid it on my desk and together we wrote the following story. I felt like this was making good progress.

> *Once upon a time there was a big fish that was in a lake that everybody wanted. Every day many people gathered at the lake with all kinds of fishing equipment to try and catch it. The big fish didn't like worms. Every day the people wasted many worms trying to land the fish. This won man used some meat of a shark and he got a bite and when that guy started reeling in the fish pulled him in the water. When the people saw this they were more convinced than ever the fish must really be a big one and they tried even harder to catch it. This other man heard the news that everybody was trying to catch the big fish. The man drove from Texas to Florida to try to catch it at the big lake.*
>
> *He brought with him a whole trailer full of equipment and was certain he would be victorious over the fish. This guy besides a car he bought a big dump truck with a big stuffed shark that he caught. The man who owned the lake was getting very upset with all the traffic going and coming from the lake. He decided to charge a fee. It would be a dollar a hour.*
>
> *The man made a lot of money but no one ever caught the big fish. The end.*

I was absent three days. The substitute teacher left a note on my desk saying that Joey did not want to participate in any classroom activities. He did only the assigned work (as usual).

I heard later he spent part of the day in the principal's office.

February 1

The class chose partners and worked on an art project -- rolling paper strips and creating a winter scene. Joey did choose a partner to work with but did not participate. He watched very intently as the other students worked. I asked him if he wanted to do any particular art project and he said he wanted to paint. I gave him a box of water colors to use, but he still would not participate.

I am [illegible] a tempera painting project for next week.

February [illegible]-13

Joey was absent with the flu.

February 14

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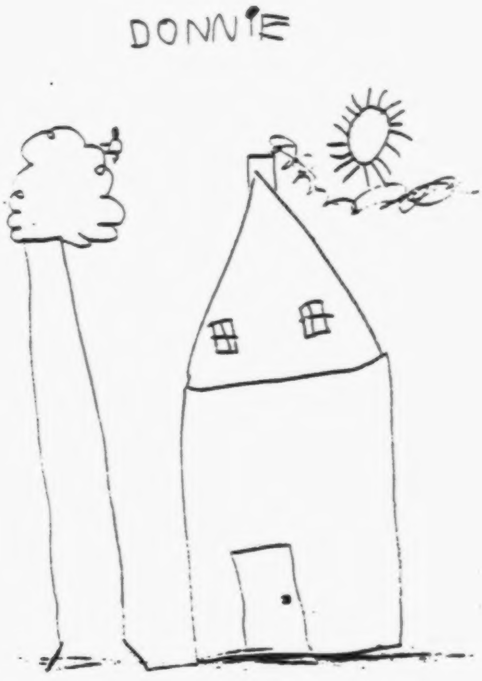

What is Collaborative Writing and Where Does It Lead?

Mary Steffen

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The basic idea: divide kids into groups of two to five. Invite them to create a story. Start by writing "Once upon a time". Each child then takes turns adding a preselected chunk of meaning,a word, phrase, or whole sentence.

Everyone notices right away that this writing assignment is fun, As stories are read aloud the teacher may notice other things: more lengthy stories, more elaborate themes, more varied use of language, and incredible creativity. The usual unpleasantness of reading aloud doesn't happen. Teachers may well hear as I did, "Can we do this again?".

What does collaborative writing provide? Motivation? Yes, certainly but there is more.

Students have all experienced a peer model of a better story. Their individual stories improve after the group challenge.

Students loosen up enough to play with words. They have seen a story grow from a classmate's choice of words being used instead of their own, subtly suggesting that alternative searching is a useful tool. As they internalize the alternative searching process into their own individual writing, their creativity improves as well as the precision with which they choose words. Like preschoolers, they are again playing with words.

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Where does collaborative writing lead? I have shared some specifics. You will all discover many more. The real place that collaborative writing leads is to children learning from other children.

Once upon a time there were lots of frogs. They splashed water all day. The frogs got out of the water and played all day. After they played all day they went to sleep. That night they came out and danced all night. In the morning they went looking for food. They started to play and jump and danced all day. - Carmen Gayden and Tavana

Once upon a time, there were four little monkeys. They spit and smiled at the other animals in the zoo. They looked and swung on the bars and the other animals were awakened because the monkeys were swinging. All night long the other animals were mad at them because they would not stop. But one night the keeper left the cage door open and the monkeys got out. The zoo keeper had a hard time getting them into the cage. Then the monkeys went to sleep. The next morning the keeper gave them a banana. When they got through they wanted more bananas. - Tammie and Ohala

Diary of a Student
4th Grade

Ruby Mack

I have had Joey (a pseudonym) in my classroom since school began in August. He never wanted to participate in any classroom activities. He did only the assigned work. He is an average student.

January 22

Today we wrote our first story with a partner. Each student contributed a sentence, then passed the paper back and forth until the story was finished. Joey would not accept a partner. After the other students began to write with their partners, I wrote the first line of a story and laid it on his desk and together, he and I wrote the following story.

> *Once upon a time there was a small monkey who lived in the jungle. That little brown monkey was named Cheta. When she was very young her mother was killed by a hunter. Cheta was very scared of the jungle. She wondered what would happen to her. She saw some bananas but she couldn't reach so she tried to climb the tree but she couldn't when a lion came along she climbed a tree with a lot of branches but she still couldn't reach then jumped and missed she tried again and she made it. As she sat on the ground eating her bananas another monkey came along and stole some of her food. She went along down a trail. She saw something good started to hear drums she went on further and before you know it was in a trap that the head-hunters had made. Now she was really frightened and wondered is she was going to die. They took her out of the trap. She was frightened. She fell asleep next couple of hours. She woke up with headhunters around her. They started feeding her the food. She smelled a soup and some bananas with it. Some of the children in the village began to shout, Look at the cute monkey. I want her! I want her! The kids in the village got to playing with the cute monkey. She never had to go without food or friends again. Finally the headhunters let the monkey go back in the jungle with a lot of bananas. The End.*

January 23

Joey would not participate in the classroom activity.

January 24

He did not participate in the classroom activity. However, he did not turn his chair to the wall during our reading group.

January 25

Joey was absent.

January 28

Today he joined his reading group but there was no oral participation. We wrote another story. He would not accept a partner assigned to him, nor would he choose a partner. After the other students began to write, Joey wrote the first line to a story, laid it on my desk and together we wrote the following story. I felt like this was making good progress.

> *Once upon a time there was a big fish that was in a lake that everybody wanted. Every day many people gathered at the lake with all kinds of fishing equipment to try and catch it. The big fish didn't like worms. Every day the people wasted many worms trying to land the fish. This won man used some meat of a shark and he got a bite and when that guy started reeling in the fish pulled him in the water. When the people saw this they were more convinced than ever the fish must really be a big one and they tried even harder to catch it. This other man heard the news that everybody was trying to catch the big fish. The man drove from Texas to Florida to try to catch it at the big lake.*
>
> *He brought with him a whole trailer full of equipment and was certain he would be victorious over the fish. This guy besides a car he bought a big dump truck with a big stuffed shark that he caught. The man who owned the lake was getting very upset with all the traffic going and coming from the lake. He decided to charge a fee. It would be a dollar a hour.*
>
> *The man made a lot of money but no one ever caught the big fish. The end.*

I was absent three days. The substitute teacher left a note on my desk saying that Joey did not want to participate in any classroom activities. He did only the assigned work (as usual).

I heard later he spent part of the day in the principal's office.

February 1

The class chose partners and worked on an art project -- rolling paper strips and creating a winter scene. Joey did choose a partner to work with but did not participate. He watched very intently as the other students worked. I asked him if he wanted to do any particular art project and he said he wanted to paint. I gave him a box of water colors to use, but he still would not participate.

I am planning a tempera painting project for next week.

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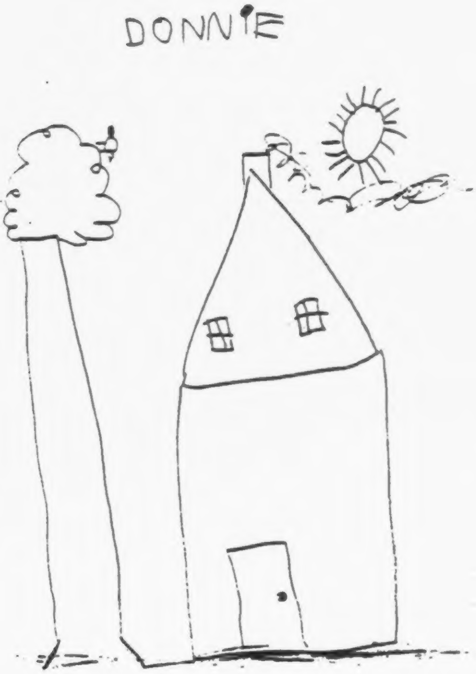

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Collaborative Writing

Mary Steffen

Space for this SEEDBED was getting tight and so we had to select only one collaborative story from the many resulting from Mary Steffen's work at Commons Lane School, Florissant. The authors are sixth graders.

The Secret Runaway

"Michelle you'd better stop going out with that street kid!" scolded Michelle's mother.

"But mom he's not what you think he is. He's really a nice guy."

"But he's a street kid, your a schoolgirl, and I don't want you going out with him."

"Well if that's all you think he is then I'm not talking to you anymore."

After that she went to her room and slammed the door.

"I wish I were never born," cried Michelle.

Michelle's life was ending. Her mother wouldn't let her go out with the only boy that ever liked her and her father was always complaining about her failing grades. But most of all her mother hated everything Michelle did, but she didn't know why.

"I have to get away from this place." Michelle said. "It's driving me nuts. I'll run away, that's what I'll do."

So she packed her suitcase and climbed out the window and down the oak tree.

When she reached her boyfriend Rick's house she said, "Hi Rick. I-I've just run away from home. Can I stay with you.

"Well I guess so."

"Oh thank you very much!" exclaimed Michelle. Then she gave him a kiss.

"Hey I got a great idea. Why don't we both run away together?"

"Hey that is a great idea. I'll pack your clothes while you find some money."

Ten minutes later they hopped into the van and drove off.

They just got out of the subdivision and Michelle started crying. "Take me home Rick, I want to go home."

"But . . . but I thought . . ."

"I'm sorry, take me home."

So he took her home and she climbed up the oak tree and went to bed. Her parents never knew she ran away. The End.

Melinda Louise Ploudre - Karen Leslie Schrage - Susan Beth Von Derau

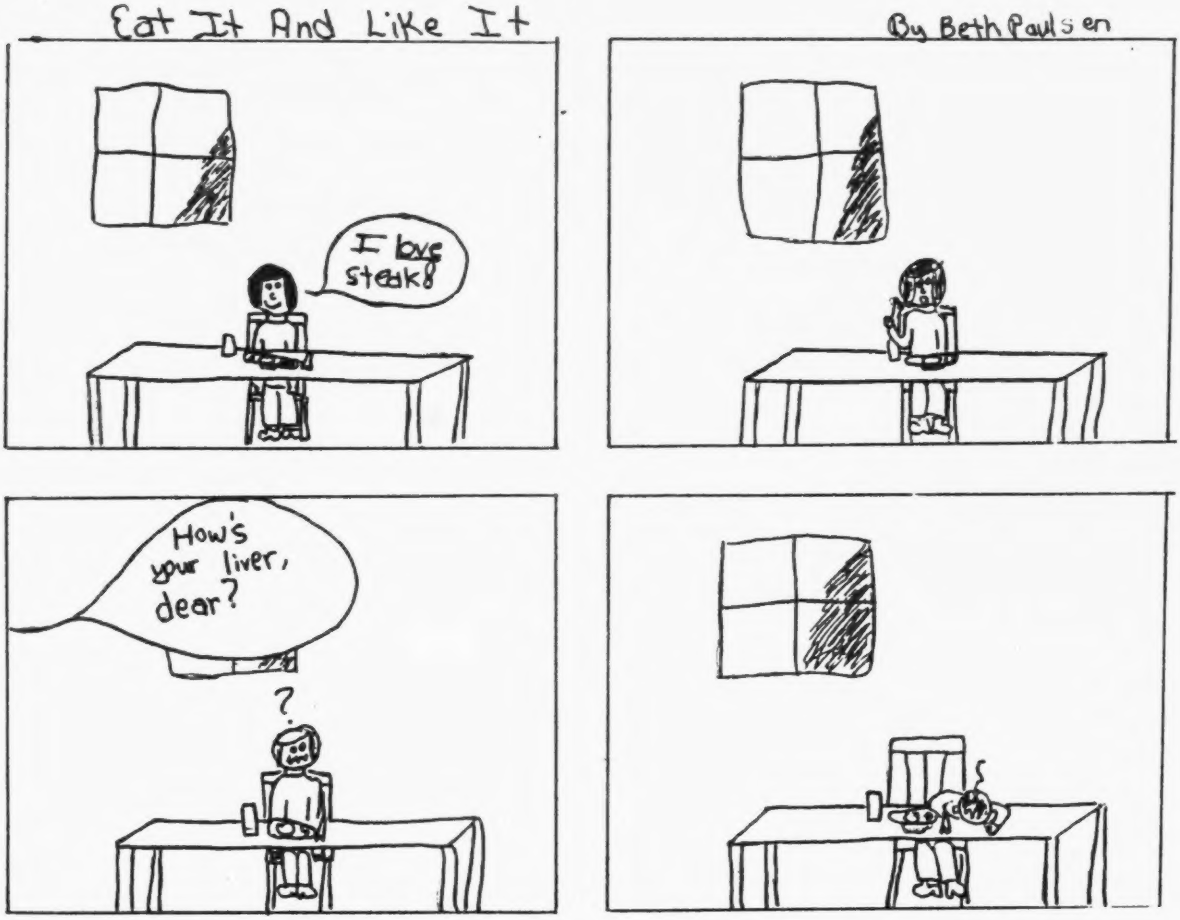
Make a Cartoon

Mary Steffen

This project is especially good as an opener for creative writing in September, but seems to ooze unpredictably into other areas as well.

Suggestions for getting started and avoiding unnecessary frustration.

1. Write the words first, then draw the bubble around the words.
2. Encourage stick figures. Draw clothes on them to make them more real.
3. Decide how many frames you need before you start drawing.



Eat It And Like It

By Beth Paulsen

I love steak!
How's your liver, dear?
?

Collaborative Cloze Writing

Here's a story taken from the February 1979 issue of Reader's Digest which we teachers used to get a feel for the issue. We worked in groups of four to argue out the best fit for each blank, then compared our results. Try it! We think that this story is not one for children; teachers must select stories appropriate at the kiddies' level; this is an adult story.

To Ride an Elephant

Babs H. Deal

Everyone should, when very young, realize a dream. It ______ you a kind of faith to take into the ______ land of the future, a belief in the possibilities ______ life. It should be a big dream, an important ______, and one you believe to be impossible of fulfillment-- ______ starring in the school play, or eating a whole ______ cake all by yourself. My dream was to ride a ______ elephant.

During the Depression, small circuses came through our ______ town only occasionally, and often they didn't have an ______ at all. There was no nearby zoo, so that ______ seeing an elephant was rare--to ride one, impossible.

______ I loved elephants. They seemed to me the largest ______ kindest of creatures, a message from nature that the ______ things didn't always come in small packages--a message ______ needed to believe in since I was anything but ______ myself. The thought of sitting atop an elephant betokened ______. From such a lofty perch surely the world would ______ beautiful, and surely so would I.

I needed to ______ in something like an elephant ride the year I ______ nine. My mother had just died and my father ______ taken a job in another town. I lived with ______ grandmother; I loved her and was treated well, but ______ world was strange. Often I would look at the ______ of little ivory elephants on the living-room mantel and ______ of real ones, knowing them beyond me forever.

It ______ like that the autumn evening I saw the circus ______ on the way home from school. We had always ______ when a circus came to town, my mother and ______ and I. But this year, I wasn't sure. I ______ picture my grandmother sitting with me under the canvas ______ a road-tattered tent. I stood in the afternoon light, ______ at the red-and-blue clown faces, the tutued ladies, the ______ with lifted trunk, and I was suddenly lonelier than ______ ever been.

There were to be two performances on ______. That afternoon, I sat in the swing in the ______ tree and read a book, trying not to think of the sawdust up the road, the elephant, the vanished ______ when Mother and Daddy and I would have gone ______ into the magic tent.

Then at five o'clock my ______ car stopped at the gate. "Hello, honey," he said ______ I ran toward him. "I heard there was a ______ in town, and figured I might persuade you to ______."

He had taken the afternoon off from work and ______ 60 miles to get me, but I didn't know that ______.

The tent, which was pitched in a lot on ______ edge of town, was not even half full. An ______ wind blew under the flaps, and the few spectators ______ together in the center of the bleachers kept their ______ in their pockets. But none of us cared. There ______ clowns, a bareback rider and a trapeze performer. There ______ dogs and horses and a juggler of bright-colored balls. ______ a moment, in a dark night in a dark ______

Then the ______ was talking again. I didn't listen.

"Now's your chance," ______father said.

"What?"

"He's calling for girls who want to ______ the elephant. That's you, isn't it?"

I stared at ______father, and at Susie. I couldn't do it; it ______ impossible.

"Go on," he urged, "before it's too late."

"______can't," I said. I couldn't get up, go down ______bleachers and perch in glory on Susie. I would ______ still past the moment of choice. Then the irrevocable ______ of loss would come, and I would know forever ______ I could have ridden an elephant and hadn't. That ______ the way I was.

But my father was talking ______. "Get up, honey, so the ringmaster will see you." ______, he pushed me to my feet.

"Come on," the ______ said. "I knew there must be at least one ______ girl who wanted to ride the elephant."

I descended ______bleachers, my feet numb, and stepped across the ring ______. Three more girls followed me. I stood in the ______ of the ring, smelling the sawdust, smelling Susie, afraid ______ of the elephant or the people watching or the ______ ahead, but of the enormousness of actually realizing my ______.

We climbed on Susie. Her hide was rough and ______against my bare legs. I held the harness in ______ of me and another girl held me around the ______. Then Susie stood up, and I was there, high ______ the world on the back of an elephant.

That ______ the last circus my father ever took me to, but I could live without circuses after that. I had ridden an ______.

And so ever after, whenever something seemed too hard ______ do, I remembered that moment; the hard glare of ______, the cold wind under the tent, and the bitter ______, I can't, and it will be too late. Then ______ remembered my father's voice and the one small push ______ the ringmaster saying, "I knew there was one little ______ who wanted to ride the elephant." When it was ______question of marriage and no job, a question of ______ the long chance on the future, always there has ______ in my mind a girl who wanted to ride ______ elephant--and did--and who therefore knows she can.

Collaborative Cloze Writing

This story--again an adult story--was taken from the October 1979 issue of Reader's Digest. We found it immensely productive but warn that the story is not likely to be fruitful with elementary school children. It's given here for teachers to try out, so that they can get a feel for what's involved.

The Once-in-a-Lifetime Dive

Grady James Robinson

I peered down through the willow leaves into the ______ and green water of Jackass Junction, concentrating, psyching myself ______ execute a dive that no other sane human being ______ dare attempt. This performance, I was convinced, would live ______ in the minds of those who watched. My toes ______ from gripping the willow branches between them. My lily-white ______ bottom flashed brazenly at passing motorists on Highway 10, ______ 300 yards away.

"Do it!" they screamed from below.

______ of the guys had already performed their top vote-getting ______. Each in turn had climbed the tree, described to ______present his own personal dive--and jumped. But this ______ be my all-time best, the once-in-a-lifetime: a forward-flip-catch-a-Snicker-in-midair (thrown from the creek bank at the precise moment)-water ______. It would win the World Series of belly whoppers.

______ had started in May of 1957, these daily treks ______the best swimming hole around Greenwood, Ark. We rode ______fenderless bicycles out to the second bridge on Highway ______. Usually the whole gang showed up, and just about ______ rode a bicycle. Everybody, that is, except Willard T. ______. He usually just appeared out of the bushes, or ______would spot him wading from upstream or crawling through ______ thick brush along the banks. We'd be swimming or ______ chase when all of a sudden there would be ______ T., with that strange look on his face.

His family ______ moved into town from a far-off region - Louisiana or ______. He never joined in the ______ or the diving contests. He was very skinny and ______ olive-green skin and slanted brown eyes. Everyone thought Willard T. ______ a little strange. One day he brought a snake ______ school. That did it: everyone knew then that Willard T. ______ not been blessed with a full deck. Any sane, ______, red-blooded American was deathly afraid of snakes, especially cotton-mouth ______ moccasins.

During the summer, the intrusion of a cottonmouth ______ the only thing that could separate us from the ______ waters of Jackass Junction. An Arkansas thunderstorm couldn't budge ______, even the kind that rolled in from southwest Oklahoma, ______ lightning bolts like buckshot. Nor could a tornado ______ the blessed news of an unprotected watermelon patch make ______ move. Only one thing, one obscene word - snake - could ______ the water in an instant.

But now I was ______ to dive. "Okay," I yelled at Billy Joe, my ______ Snicker thrower. "Don't throw until after I come out ______ the flip. You hear? After!"

For one instant I ______ the competition. David, my brother, whistling through his teeth, ______ performed the majestic and impressive cherry-bomb dive, a ______ crowd pleaser. But the one I had to beat ______ my old friend and companion, Joe Staddford. Joe's number ______ called the cow-pasture-sprint-leap-over-the-barbed- ______ - fence-head-first-special. Truly a magnificent combination of ______, raw nerve and sheer idiocy. The kid was fast . ______backed off through the pasture of the Circle L ______ and, after a deep breath, began the sprint. Dodging ______, stickers, stumps, and fresh cow piles, he dived over ______ barbed-wire fence with reckless abandon. He then crashed ______ the thick bushes at the water's edge and tumbled ______ the water. To top that number and win the ______ prize--a sack of Hershey bars and two Snickers-______ have to come up with a real show-stopper.

"______, this is it," I yelled again. "You ready, Billy ______?"

"Ready!"

"Here goes!"

I looked at the water, I ______. I began the never-before-attempted forward-flip-catch- ______ -Snicker-in-midair-and-eat-it-before-you-hit-the-______-dive. It was my moment in time. I forced ______head forward and from my upside-down position saw ______ bank, willow-tree trunk, willow-tree top, blue sky, ______bank, staring faces, green foamy water.

Then--just as ______ Joe drew his arm back to throw the Snicker--______ screamed, "Snaaaaaake!"

The cry sent chills through my gyrating ______.

"Snake! Snake! Snake!" roared from a dozen throats. I ______ what little control I had and came out of ______ forward flip somewhere south of China, my legs pumping ______pistons. I saw a chocolate-brown blur coming at ______ at high speed against a background of scrampering bodies, ______and spraying water.

Where was the snake?

I ______ out frantically in the general direction of the blur, ______ it and shoved it into my mouth just as ______ tender stomach hit the surface of Jackass Junction.

Then ______ was underwater with a mouth full of Snicker and ______ creek water. I couldn't breathe, but that was not ______ as important as the location of the intruder. The ______ King swam somewhere in the same pool with the ______ me.

When my head finally appeared above the surface, ______ yelled, "Get out, you idiot!"

My friends dragged me ______ the side of the bank and stood in silence ______ the snake glide effortlessly and quietly through the middle ______ our innocent young lives.

"Didja see me? I caught ______. Didja see it?" I gasped.

"Lookit the size of ______ dude," Kenny said in awe. I looked for the ______ time and saw a huge cottonmouth water moccasin only ______ few feet from the bank on which we were ______. The intruder, symbolic of another snake in another garden ______ innocence, paraded triumphantly the entire length of the ______ and then returned as if to mock us. We ______ in helpless silence.

Then it happened. From the very ______ of the willow tree a trumpet call sounded forth across ______ fields. "EEE-iiijjjhhhh!"

Plummeting swiftly through the air, descending straight ______ toward the huge cottonmouth, was none other than Willard T. ______. "Snnnnnnaaaaake diiiiiiiiiiive!" he cried.

He hit the water directly ______ top of the snake and disappeared. Then a dark ______ appeared just beneath the surface of the water -- it ______ the burrhead haircut of Willard T. as he came ______ laughing and gasping for air.

"I got 'im!" he ______.

He raised his right arm from beneath the water. ______rattled as a dozen boys took one giant step ______, for the big cottonmouth, all eight feet, was wrapped ______ Willard T.'s skinny arm. He crawled out on the dirt ______, being careful not to pinch or irritate his captive. ______ snake didn't appear to be disturbed; his tongue flicked ______ darted from his large head; his small eyes seemed ______ speak. Willard T. smiled his funny little smile that revealed ______ teeth.

"He wins," someone said.

"Yeah, snake dive wins."

"______!" said another.

A sack of melted Hershey bars and ______ Snickers landed at Willard T.'s feet. He picked up his ______Levi's with his left hand and tossed them over ______ shoulder and, with the cottonmouth curled around his arm ______ neck, sloshed upstream. He was licking melted chocolate from ______ Hershey wrapper and whispering to his new friend as ______ disappeared into the underbrush.

We dressed in uncommon silence.

"______ anybody see my dive?" I asked. "I caught the ______ thing!"

There was no answer.

Anthony Miller

Advantages of Writing

Fill - In - Stories in Groups

Jewel Birge
Lillie Mixon

1. This activity can be used to help the students in selecting a variety of words that would make sense in the blank spaces. It increases their vocabulary skills because the children listen to one another's alternatives.
2. The students develop inter-personal abilities in trying to find the word that seems most appropriate in the blank space. They are forced to argue out a decision as to what word to use.
3. This activity helps to increase their grammar usage and also allows the students to relate to the context of the story and make the best possible choice of words for that particular story.

Collaborative Cloze Writing

Diann Williams
Bobby Bean

This story, report Diann Williams and Bobby Bean, goes will with upper elementary children. It was taken, we're told, from "An Old Reader."

A King's Treasure

Long ago, there ______ a rich King. He was so ______ he could not finish counting his money. His dishes were made of gold. His floors sparkled with ______. Yet he was not ______. He wanted to own all the ______ of the world.

One day a wise man came to see the king. "I hear you are ______ for treasure", said the ______ man. "Go to the desert. There you will find the ______ treasure in the world. Without this treasure, the ______ man is poor."

"What is this ______?" cried the King.

"______ cannot tell you", said the wise man. "You must ______ it for ______."

Next ______, the King took ______ camels and a servant and started out for the ______.

"Keep your ______open", the King said. "There is a ______ treasure here."

"What ______ I look for?" the ______ asked.

"I do not know," said the King.

"Just ______."

All ______ long the King and his servant ______ the desert. But all they ______ was the hot sun and the dry ______. Next ______ there was a sandstorm. When the storm was over, the ______ men were ______. And the camels were ______.

"We are lost. And we have no water. We will ______", ______ servant cried.

"We must walk ______ we find our way", said the King. For ______ they walked. At last the servant could not go ______.

"Water!" he called. "Give me ______ or I shall ______."

"I would give ______ my riches for one ______ of water", the King said ______. He walked on, then ______ back, shouting, "I ______ water! ______ see water!" The two ______ began to ______. When they ______ the water, they ______ down beside ______ and began ______drink. It ______ as if they ______ never stop drinking.

Later, when they had rested, the ______ said, "I can ______ on now, my King. Shall ______ keep looking for the treasure?"

"No", said the King. "Now we ______find our way ______."

"What?" said the servant. "Go home ______ finding the ______ first?"

"We have found ______", said the King. He pointed ______ the water. "The wise man ______ right. We have found the ______ treasure ______ the world."

Going to the Circus

Dianne Anthony
Nellie Rush

This story, say authors Dianne and Nellie, went very well with first graders.

Our class went to the circus. We __________on a big __________bus. It took a _______time to get there. When we got to the circus, we were so ______.

We saw a large _____and lots of ______. As we went into the ______, there was a ________clown. He was riding a one wheel _______. At first, he would _______from one side to the other. We thought he would ________. But then he would ______and _________to us.

At last the show was on the way. We saw many exciting and funny things. There were ______, _______, and a _________. The _______ was my favorite. We had a ______ time. We hope we can go ______.

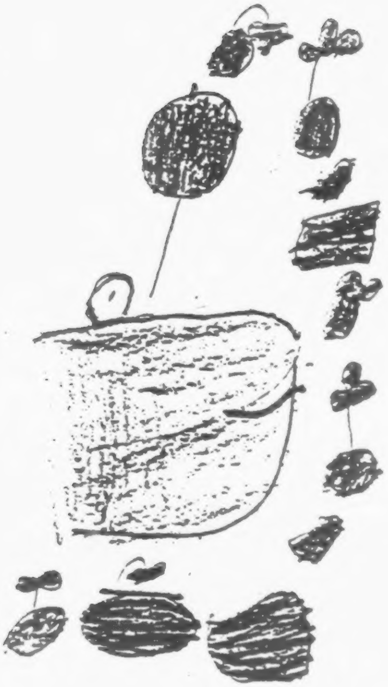
Collaborative Writing
Nellie Rush
Dianne Anthony

This story comes from first graders at Maplewood School, Cahokia District 187

A Hippo

by
Danny Bardy
Angel
and
Dia

Once there was a big, fat Hippo. His name was Clown. He wanted to eat all the time. No one gave him any food. because, he was too fat.



His stomach stuck out like a big balloon. Everybody wanted the Hippo to loose weight. So the Hippo had to swim a mile each day to loose weight.

The Hippo
lost 300 lbs.
Now the Hippo
was small
and thin. I
bet the Hippo
never ate
a lots of food
again. Do you?
The
End

Math

and

Thinking

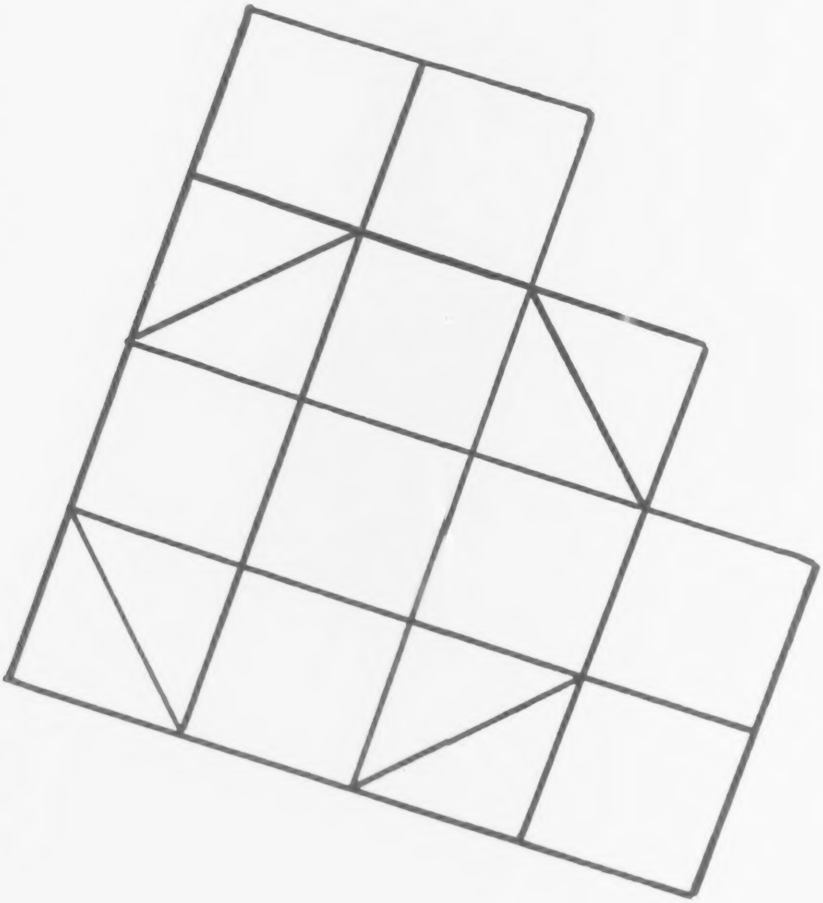
A Game for Squares

Lois Daesch

How many squares can you find in this design?

15 is good. 17 is better! Find 20 and you are a real square!

If you have solved that, now how many rectangles can you find? That's not the end. Name all the geometric figures you can see in this design. How manv of each?



Kindergarten Children Count the Squares

Sue Crowe

I used the "A Game for Squares" Activity that Lois Daesch shared with us at the Belleville Area Teachers' Center with my kindergarten class.

I enlarged the original squared puzzle and cut out different colored squares for each size represented as well as other shapes that could be seen.

I worked with one child at a time asking him/her to count the squares. The first girl, Jennifer, is an above average student and she could visualize all the different squares in the figure by having the colored cutout squares before her. She laid them on top of each other which meant she could remember what was underneath. She moved rapidly with only a few suggestions or hints from me. She added the squares by saying 13 and 3 more is 16 then she wrote down 16. She added all other squares, sometimes one more at a time, sometimes adding 2 or 3 to last number.

Most of the other children did not "see" the larger squares as quickly or at all. If the squares were covered up they could not remember the outline underneath. They all did not see the two triangles in the figure as a square until they placed the two cutout triangles together to form a square. The children still enjoy working with the puzzle. I encourage them to experiment along some or in pairs and only offer help when it's needed. Once the children have found all the different shapes, they delight in showing others.

Venn Diagrams and Social Studies

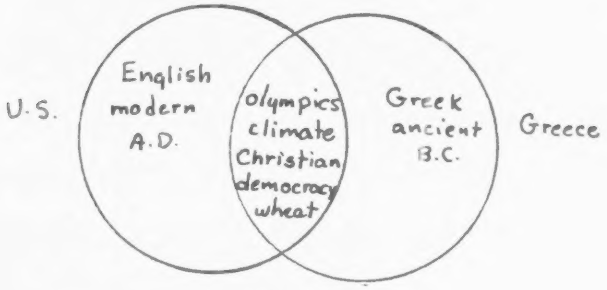
Anna Breeden

The use of Venn Diagrams is often limited to the mathematics classroom. They are often used to depict various relationships between number stystems and they are used in logic study.

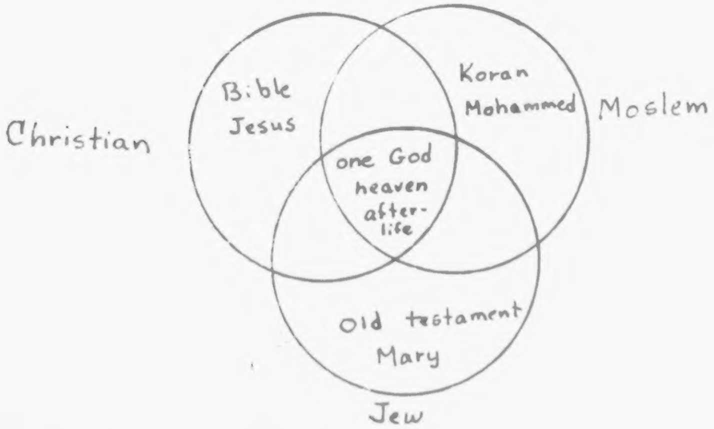
My own background in teaching at the elementary level has been in reading and social studies. I have recently been reintroduced to Venn Diagrams at the Belleville Area Teachers' Center. I realize that Venn Diagrams would be very useful to my sixth grade social studies class in understanding relationships between the cultures, religions and countries studied over the course of a school year.

My students had had some introduction to the concept of Venn Diagrams in their mathematics classes. I wanted to see if the students could use Venn Diagrams to show how several major religions and countries offered or were alike. The results demonstrated that they could and enjoyed doing so.

We began by working several mathematical problems. I then asked whether Venn Diagrams could be used in our study of world religions. After a short discussion one of the students suggested using Venn Diagrams to determine what several major religions had in common and how they differed. We chose the Moslem (Islamic), Jewish and Christian religions. The students displayed much enthusiasm in creating their Venn Diagrams. What had previously been boring lists of similarities and differences were now graphically displayed in a manner that had meaning to the students. Below is an example of the Venn Diagram we did on major world religions.


U.S.
English
modern
A.D.
olympics
climate
Christian
democracy
wheat
Greek
ancient
B.C.
Greece

We also applied the use of Venn Diagrams to another lesson recently completed, a study of Greece. One of my students suggested that we compare Greece to the United States. Again they enthusiastically attacked the problem and came up with some very interesting results. Following is an example of that comparison.


Christian
Bible
Jesus
Koran
Mohammed
Moslem
one God
heaven
after-
life
Old testament
Mary
Jew

The use of Venn Diagrams is not limited to mathematics and social studies. Almost every subject taught in school is fertile ground for the use of Ven Diagrams. For example, what better method could be used to study nouns, verbs and nouns that are also used as verbs. What about the similarities and differences between birds and mammals?

The use of Venn Diagrams is only limited by our own minds. I do not propose the wholesale use of Venn Diagrams in every subject--Venn Diagrams are just one of many techniques available to the elementary classroom teacher--but I challenge you to try adding Venn Diagrams to your teaching "bag of tricks." Have you thought of some ways to use Venn Diagrams?

Making Story Problems Fun and Educational

Kathie J. Van Kuiken

Working story problems can be a bewildering chore for both the student and the teacher. Here's an idea that you may enjoy trying.

The Macmillan Math Series (fifth grade level) has a great two-page colored diagram in the beginning fraction unit. The diagram contains numerous activities that are occurring on a beach. (A representative drawing shown on following page.) The authors of the text suggest the children make up some story problems using the picture as a guide. We decided to tackle the task.

I got the class started by asking them general questions about the picture. For example, "How many people have bikinis on?" "How many different sport activities are going on?" "How many people are in the water?" We then talked about how we had set up and solved whole number story problems earlier in the year. We discussed how we were going to have to change some of our wording in the problems to fit the properties of fractional numbers.

We followed a simple format. The first sentence would explain what general object or activity we were talking about. The second sentence would ask, "How many are ...?" The third sentence would ask, "What fractional part of the whole is or are ...?" We then drew up an example together as a class to follow the format. Example: "There are 29 people on the beach. How many of them are boys? What fractional part of all the people on the beach are boys?"

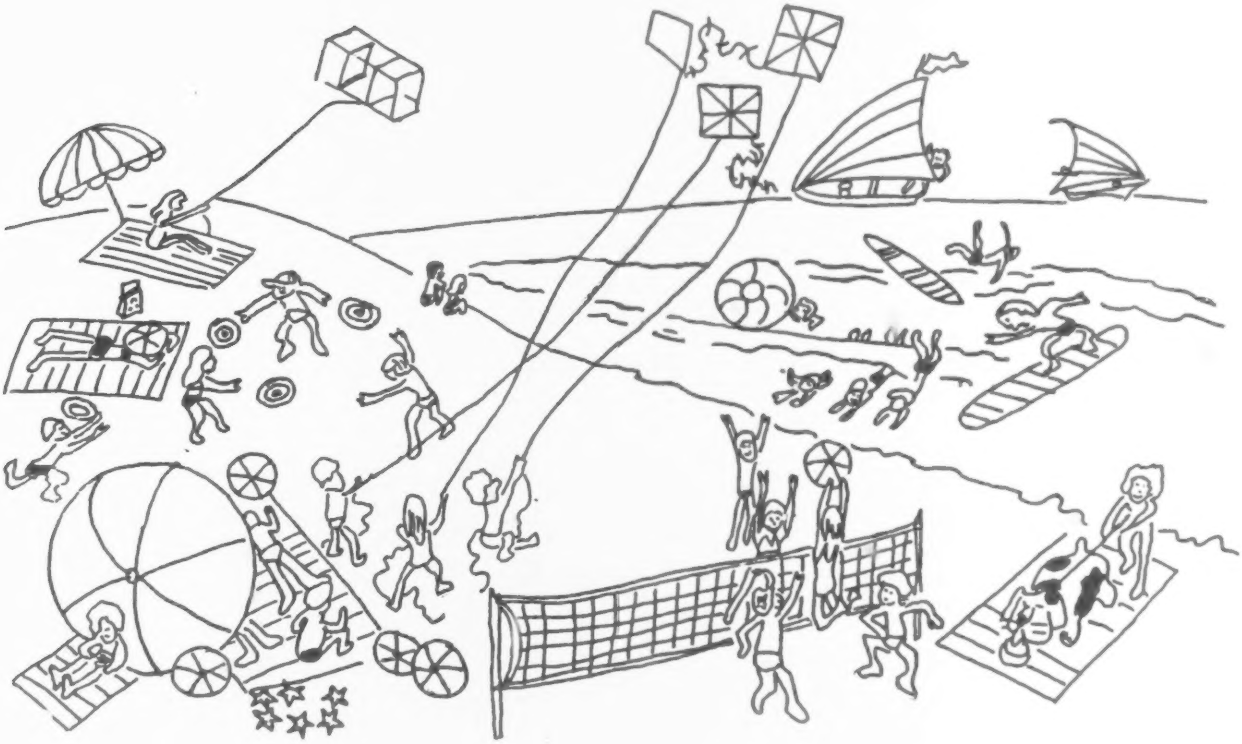
We then divided into pairs. Each of the children were to make up two story problems each. Their partners were there to help them. I then collected them at the end of the period and for homework, I gave each student someone else's story problems to solve. They were asked not to ask the person whose problem they had any questions. They were to try to answer them the best they could without help from anyone. The children thought it was a pretty fair rule.

The next day I had the children read the story problem they had been given to solve. We came up with some general comments about writing story problems. Having them try to understand someone else's story problem was a good experience.

Following are some of the general comments the children came up with during the experience.

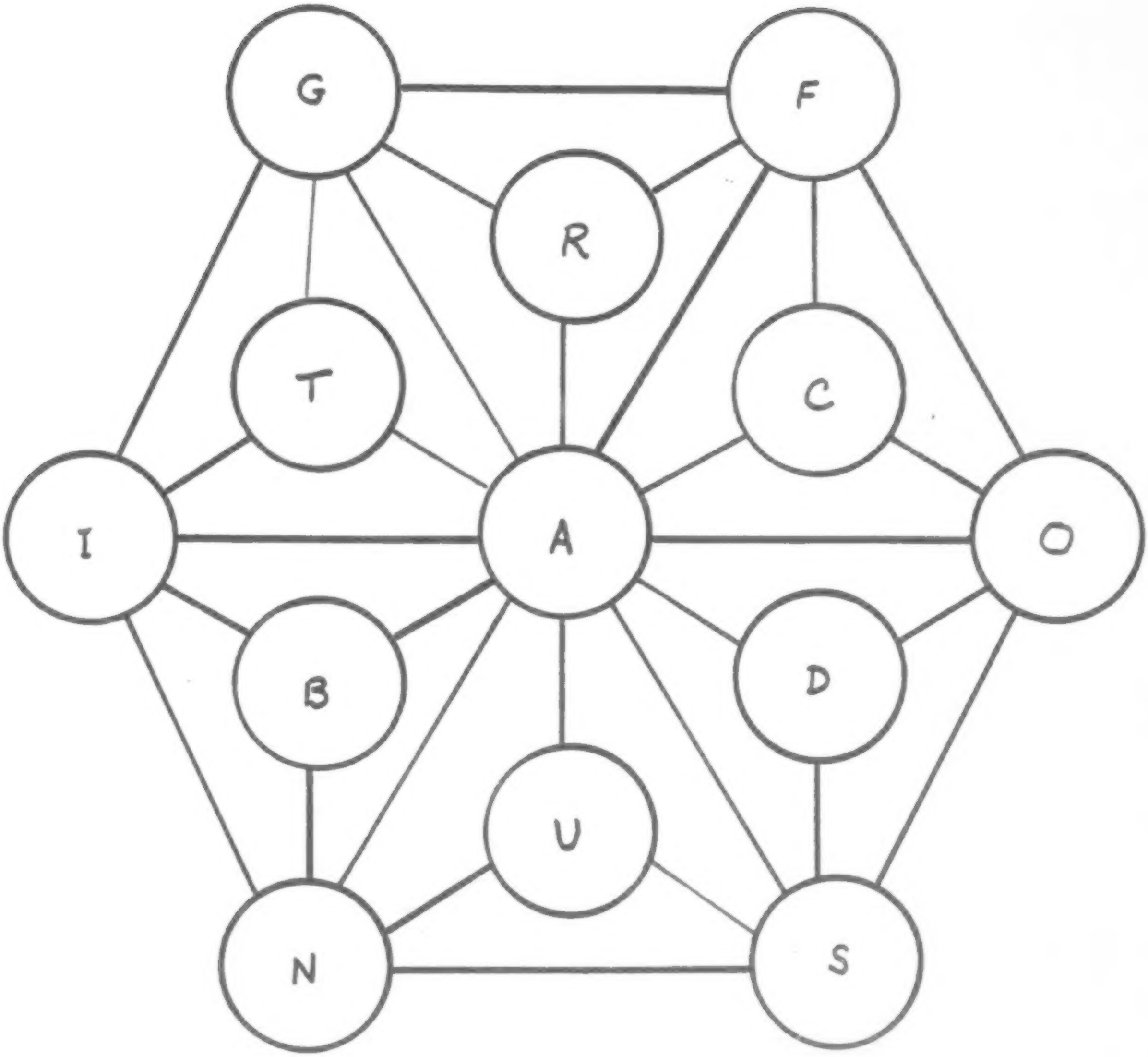
1. What we write someone else might not be able to understand. We must be careful to think of the reader.
2. The choice of words (and the correct sequence) is important.
3. We must make sure that the first statement in the problem agrees with what we are asking in the final question, otherwise the problem cannot be solved or it may be solved differently than that which was anticipated.

The children really enjoyed the activity. At first the children complained that it was too hard, but by the end of the experience they wanted to know when we could try it again. It could be and was a downright fun and educational experience!



p. 148-149
Macmillan Mathematics
Series 8th Grade

Word Web


G
F
R
T
C
I
A
O
B
D
U
N
S

Find as many three letter words as you can.

Word Web

Joan Barnes

I received the attached Word Web at the annual Right to Read Title I Conference in Carbondale, Illinois.

The object is to see how many three letter words you can make by following connecting lines from one letter to another.

Example: cab
sun
rat

Kangaroo Words

Joan Barnes

As you know a mother kangaroo hides her baby in a pouch. Hidden in the words are small words. See if you can pick them out. Write the word and then write the smaller words under it.

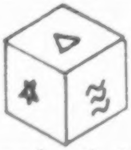
father
sister
stop
basket
father
together
boats
gone
brother
stand
chant

Example: father
fat
at
her
the

Build a Cube Like Mine

Fred Habermehl

Construct a cube from a net like the one on the next page. Draw a different simple design on each face of the cube. Fasten a string to your cube and hang it where it can be seen by all the children.



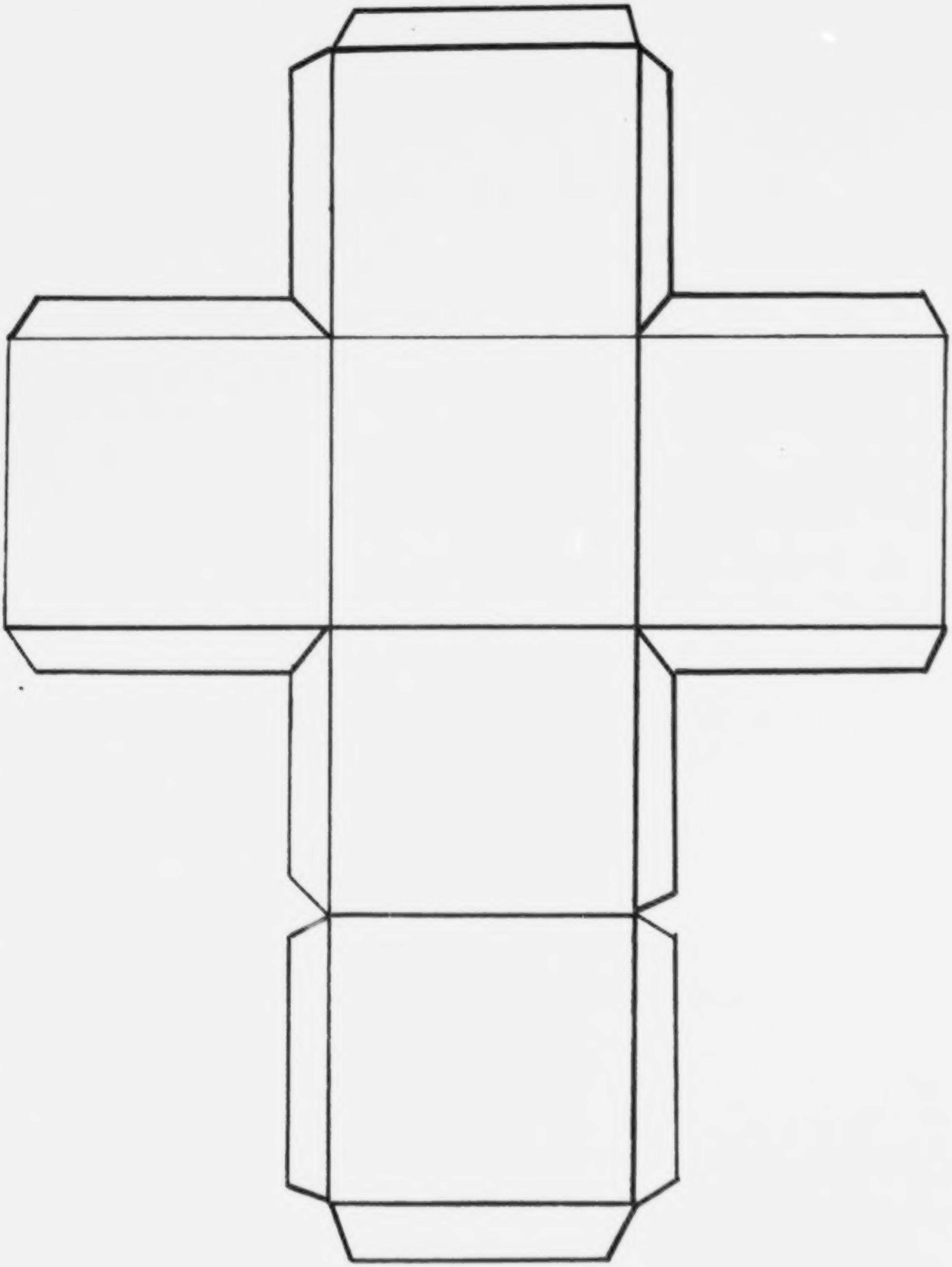
Give each child a net and ask him/her to make a cube exactly like yours. Provide scissors, tape and crayons or markers.

Watch what happens!

Variations: 1. Don't provide the net.

2. Require that the designs be put on the net before it is made into a cube.
3. Make this a small group activity rather than an individual one.
4. Use shapes other than the cube.

This idea came from Summer Workshop for the gifted presented by Area Service Center, Belleville, Il.



Wait-time

Liz Anderson

Here is an idea to start getting reluctant contributors to answer in class. Rather than as a teacher being a producer of questions for the class all day long -- slow down. Try waiting for three seconds after you have asked a question before you call on someone in the class to After a child does respond, wait another three seconds before you say anything. It is not easy -- in the beginning. Amazing changes in the verbal interactions in the classroom can be seen to be developing. Extensive research, especially by Mary Budd Rowe, shows that teachers ask between three and five questions per minute. Before any listening takes place on the teacher's part, the next question has been popped out to the class.

Too often one becomes wedded to the routine of "covering the material". But learning takes time. Building concepts cannot be accomplished in a rapid dialogue situation. It is no wonder that the children are often in a state of question shock at the end of the day. And the teacher who has been the inquisitor is exhausted.

Different techniques can help the teacher learn to extend wait-time.

1. Actually be a clock watcher. Make yourself wait a given time period before you say anything.
2. Make the kids part of the act. Let them in on the fact that changes will be taking place in classroom dialogue.
3. Science might be a good place to begin extending wait-time.

Students can begin to use the time allowed to develop speculative thinking. Rather than one word replies, responses now sometimes are "It may be . . . ." When a fellow classmate begins an answer like that, other students in the class are likely to contribute to the developing ideas. Once this is underway, the teacher does not ask as many questions. The children are structuring their own learning experiences. More children are talking and longer answers are given. A different atmosphere has developed in the classroom. Try it and discover the difference.

Criss-Cross

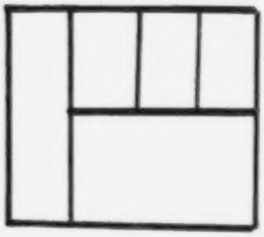
Fred Habermehl

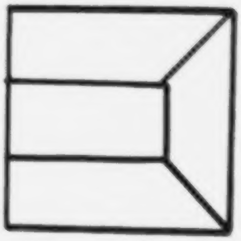
Put the letters A, B, C, D and E in this chart so that no letter appears twice in any row, column or diagonal. All blanks are to be filled.

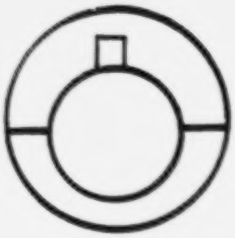
Maps

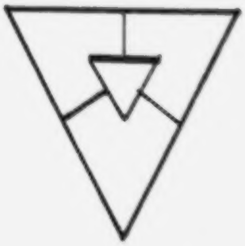
Anna Breeden

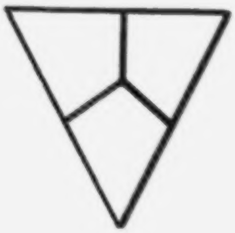
The following diagrams are maps of countries in various parts of the well-known state of Geoturf. Using crayons, find the smallest number of colors needed to color each map. The only rule is that no regions with a common side can be the same color. (If they have only one point in common, they may be the same color.)

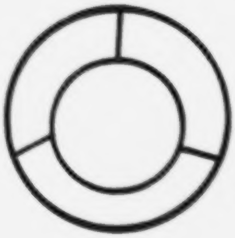


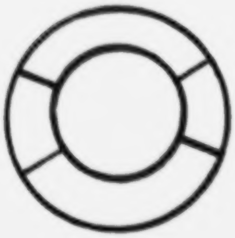


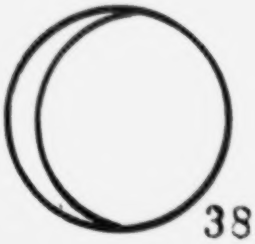


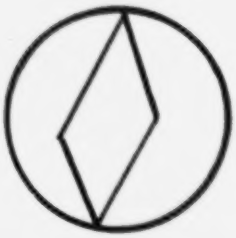












Joints or Joints?

Helen Miller
Logan Kindergarten

One of the many things I have learned as a kindergarten teacher is that one must never assume too much.

The vocabulary of a four or five year old may contain the same words as an adult's, but sometimes meanings of those same words are very different!

For several years, I asked children to bring hard-boiled eggs to school in order to dye them for Easter. The looks I received from the children were those of utter horror. I was planning to kill their Easter eggs! When I finally realized what the problem was and asked them to bring eggs in order to COLOR them - all was well!

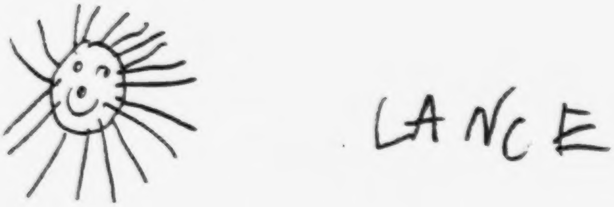
Today, we were listening to Slim Goodbody's record about parts of the body. The voice on the record asked the children to point to their joints. "Joints", said Joe, "are something that you smoke."

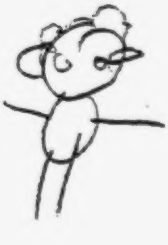
Very often, I find the simplest words cause the most trouble. A child will know all there is to know about Star Trek but he does not understand such terms as: front, back, up, down, on top of, beside, inside, outside, below, under, silverware, middle, globe, easel, map, address, etc.

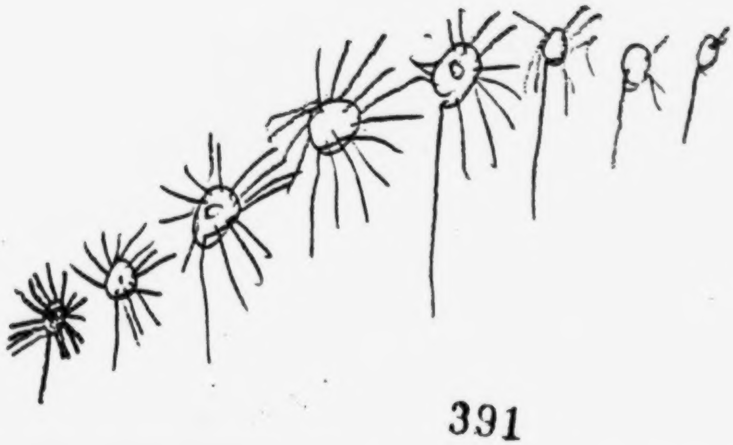
Book companies and publishers of duplicating materials fail to take this into consideration. A child's language is not the same as an adult's language as far as meaning is concerned.

My advice to any new teacher is not to assume anything! Stop to find out what the child is thinking before marking something wrong. One of the pages of our reading book had an exercise using the sound of the letter "f". The page was a picture of a girl. As I talked with him about his work I found he had marked not a picture of a girl incorrectly but he had correctly marked a picture of a "friend".

Joints or joints-----never assume, always ask!







Animal Farm

Jeanne Edgar

These Animal Farms were developed by members of Jeanne Edgar's seventh grade class at West Junior High School, Belleville.

1. These are zigziles: 5 33 121 81

   These are not zigziles: 62 39 86 7

   Which of these are zigziles: 9 16 82 13 93 35 81 85
   (Zigziles are the creation of Ricky Vines)

2. These are dogydoes: 15-145 7-21 10-30 97-291

   These are dogydoes: 3-17 100-20 86-100 2-15

   What's a dogydoe?

   (Dogydoes are the creation of Sharon Moffett)

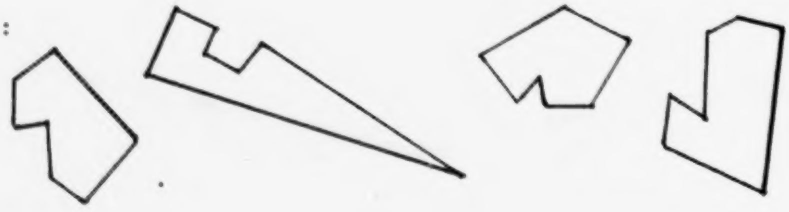
3. These are mingalings: 168-21-8 7-12-84 3-12-4 35-5-7

   These are not mingalings: 5-7-57 32-7-4 4-7-82 8-50-10

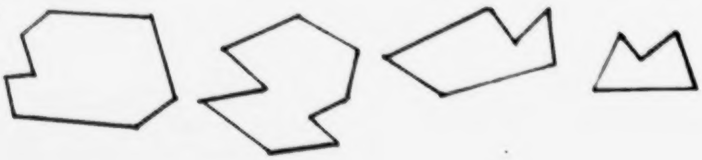
   What's a mingaling?

   (Mingalings are the creation of Julie Martin)

4. These are noodle-nockers:



   These are not noodle-nockers:



   What's a noodle-nocker?

   (Noodle-nockers are the creation of C. Kugler)

5. These are peepers: 2-2-3 7-7-48 5-5-24 9-9-80

These are not peepers: 2-2-4 8-8-91 6-6-36 7-7-7

What's a peeper?

(Peepers are the creation of Andy Ortmann)

6. These are dippydoos: 4-16-64 160-40-10 32-8-128 1520-280-1520

These are not dippydoos: 17-40-37 20-20-10 100-101-102 8-29-128

What's a dippydoo?

(Dippydoos are the creation of Pat Donahue)

7. These are parkylarkers: 58 69 47 25

These are not parkylarkers: 38 49 510 15 20

What's a parkylarker?

(Parkylarkers are the creation of Missy Kelly)

8. These are hibblehobbles: 1-4 3-12 8-67 10-103

These are not hibblehobbles: 2-5 4-17 7-50 9-82

What the dickens is a hibblehobble?

(Hibblehobbles are the creation of Lynne Alvarez)

9. These are willywinkers: 5-5-30 6-7-47 8-9-77 2-3-11

These are not willywinkers: 6-8-50 5-9-48 8-2-20 3-4-13

What is a willywinker?

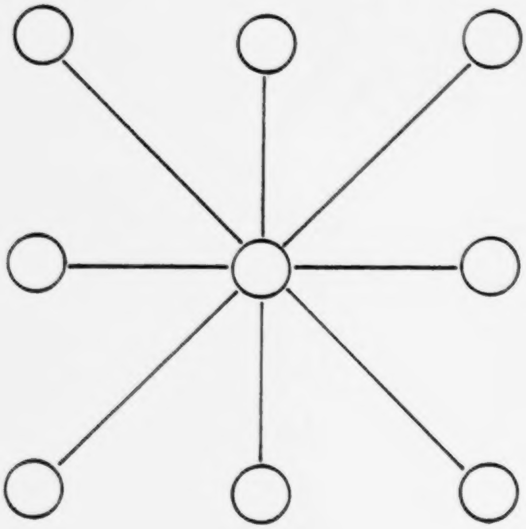
(Willywinkers are the creation of Wendy Huber)

ANSWERS

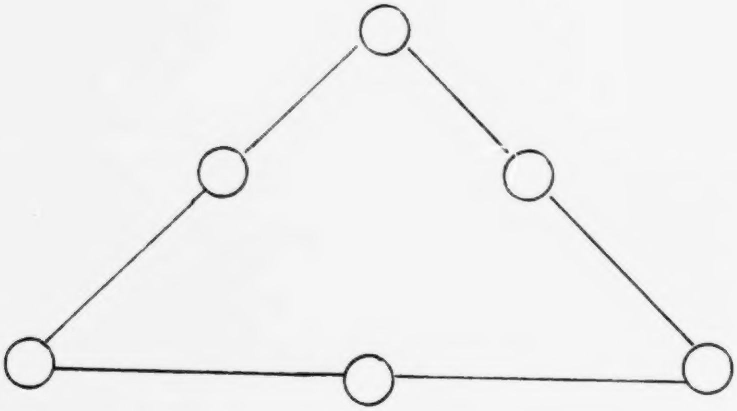
1. Each number is one more than a multiple of 4.
2. The second number is three times the first number.
3. One number is the product of the other two.
4. 7 segments.
5. One number is one less than the product of the other two.
6. One of the numbers multiplied by a constant plus another of the numbers multiplied by the same constant produces the third number.
7. The difference between the digits is 3.
8. Square the first number and add 3 to get the second number.
9. One number is five more than the product of the other two numbers.

Two Small Problems

Lorraine Allison



Fill in the missing numbers. The sums each way are 18. Use numbers 1 through 9 only once. Can you make up one yourself?



Find the missing numbers to make sums of 10 on each side. Use numbers from one to six only once.

Beauty, as Scientists Behold It

Malcolm W. Browne
The New York Times

There's something in a song, a rushing mountain creek, the night sky, the human form and a thousand other things that touches all of us occasionally, piercing the core of our primal feelings and making existence seem inexplicably good. We call it beauty.

Unfortunately, most of us can't spare much time to ponder that mysterious quality. Beauty is fine, but it doesn't do the laundry, buy groceries, cure measles, fill gas tanks or keep our enemies at bay.

Science, on the other hand, which can help do all those things seems at times as practical and ugly as a toilet plunger.

And yet, when scientists shed their dirty lab coats and don blue jeans for an evening of beer and pretzels, they talk about beauty as if it were the central driving force of their work and lives. The beauty they have in mind manifests itself as equations scribbled on blackboards rather than as poetry, concerts or Playboy centerfolds, but it is as real to then as a Bach fugue, something felt with the heart as well as the mind.

They say something startling: Beautiful solutions are better than merely practical solutions because they are more likely to reveal profound scientific truth.

Can a mass of numbers and Greek letters joined by squiggly lines really be a thing of beauty?

One of the world's leading authorities on how stars evolve, Subrahmanyan Chandrasekar of the University of Chicago, says he feels the same "thrill" beholding a beautiful mathematical relationship as he does a Michelangelo sculpture.

Disdaining sloppy thinking, scientists demand the right nut for the right bolt, but they don't think of themselves as mechanics. They like to quote Jules Henri Poincare, the great French physicist and mathematician:

"The Scientist does not study nature because it is useful to do so. He studies it because he takes pleasure in it; and he takes pleasure in it because it is beautiful. If nature were not beautiful, it would not be worth knowing and life would not be worth living."

Scientists tinker with machines that cost taxpayers hundreds of millions of dollars. To justify their work, they must sometimes go before committees of laymen to explain how their work may harness fusion energy, keep us ahead in the arms race or bring cancer under control.

Though such goals may be important, they are less important to the scientists themselves than their quest for some difficult but compellingly beautiful abstraction, such as the field equations of James Clerk Maxwell and Einstein's General Relativity. Among themselves, they speak of such things in the same awed tones as those of an architect describing a Gothic cathedral.

The ancient Greeks were elated to discover that a rectangle whose proportions are three to five is more beautiful than a simple square. Today's scientists say they sense the same artistic exhilaration from some far-reaching new discoveries about the behavior of subnuclear particles.

Until recently, traditional scientific thinking held that ultimately, everything in the universe has a symmetrically equal and opposite counterpart, and that the Asian notion of yin and yang is literally true. But a beautiful theory has led to the finding that universal symmetry (or parity) in the behavior of nuclear particles is sometimes slightly violated, and scientists believe they have come upon a truth even more beautiful than the simple perfection of symmetry.

The discovery seems to them a marvelous example of how an instinctive perception of beauty can penetrate truth more deeply than conventional logic.

When physicists think about such mysteries as gravitation and black holes, they are increasingly drawn to a class of mathematical tools called "gauge theories," which attempt to bind together two or more different kinds of relationship.

To people versed in mathematics, gauge theories often seem superbly beautiful, but they are extremely difficult to prove by scientific observation. They also sometimes seem to fly in the face of accepted wisdom. But as experimentalists grope to test some of these beautiful ideas, there is growing concrete evidence that gauge theories really do point the way to ultimate understanding of reality -- to the Grand Unified Theory of which science has long dreamed.

As the evidence mounts, the theorists smile and quote Keats: "Beauty is truth, truth beauty."

This article appeared in the New York Times on March 11, 1980.
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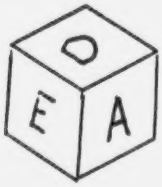
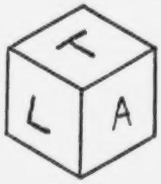
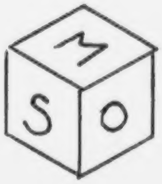
MAKE A WORD

Shirley Casey







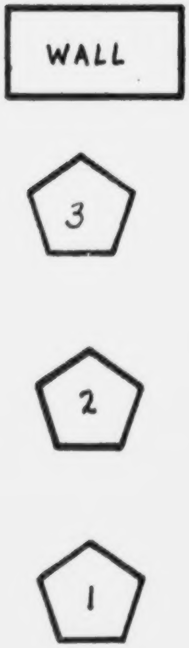
Give the children three blank dice. Tell them that they are to put a letter on each face. They will be throwing the dice and using the letters to make three-letter words. Their task is to decide which letters to use on each of the dice.

Variations:
1. One can establish the order in which the dice must be used - yellow die will be the first letter, blue die will be the middle letter and red die will be the last letter.
2. Spinners could be used in order to increase the number of letters.
3. Four or more dice could be used.
4. A space on one of the cubes could be left empty to be used as a blank Scrabble piece is used.

Hats

Fred Habermehl

Three men stood facing a wall as in the diagram at the right. They stood so that all they could see was the person(s) in front of them .



From a pool of 3 white and 2 black hats, one hat was randomly selected for each man. Therefore, the only hat(s) that any man saw was/were on the man/men in front of him.

The first man was asked if he could tell what color hat he had on. He replied that he could not. The second was asked the same question, and even though he had #1's answer to help him, he also replied negatively. When #3 was asked he immediately said, "I have a white hat on my head!" How did he know?

Variation: What would happen if the order of responses was reversed if #3 responded first, #2 second and #1 last? Would it make a difference?

What other variations are possible?

What A Good School Should Be

Neil Postman and Charles Weingartner
Chicago Tribune

A school is good...

*When its daily time sequences are not arbitrary (45 minutes for this, 45 minutes for that, etc.) but are related to what the students are doing. If something takes 20 minutes to do, why drag it out? If something takes an hour and 20 minutes to do, why cut it short?

*When children are not expected to do the same thing in the same amount of time. This amounts to a recognition of the fact that there is a difference between expecting a student to learn something and expecting him to learn something at a predetermined pace. Learning rates vary, and a good school is one that does not penalize or reward such variations but accepts it as natural.

*When students are not required merely to serve time in courses, like in a jail sentence. In a bad school, there is a preoccupation with "taking" courses, such as English 6, Social Studies 8, and Science 7. A good school is more concerned with the achievement of competence than it is with serving time. Thus, in a good school, the question is not, "Have you taken...," but "Have you learned...?

*When it moves away from adversary relationships between teacher and student and toward collaborative effort. It is difficult to institutionalize such a change; everything really depends on the willingness and ability of teachers to forgo an authoritarian role.

*When students are given opportunities to supervise themselves. For example, some schools ask students to handle discipline problems, to serve as crossing guards, to administer tests, to help keep the building in repair, and so on. The idea, of course, is to give students a sense of control in the functioning of the school. There may be no more effective way to teach the need for order and discipline.

*When the activities it requires are not arbitrary (e.g., "We've always done that") or based on discredited claims (e.g., "The study of grammar strengthens the mind"). A school is good when it can assert on some empirical and rational basis that its activities have relevance to the lives of children. This does not necessarily mean, "You can use this later in the afternoon." It does mean, "There is some demonstrable evidence that many students have, at some time or other, found these activities useful in the pursuit of an education." Of course, if you can learn something in the morning that you can use later in the afternoon, it does wonders for your morale.

*When it does not require all students to engage in the same activities, but gives them considerable latitude in choosing from among many options. Since educating oneself involves making decisions about one's activities as well as one's time, it is a good idea for a school to give students a chance to learn how to choose among activities. This does not necessarily mean there should be no requirements.

*When its activities are student activities. That may seem obvious, since it can't be much of an activity if the students aren't doing it. But the fact is that in many schools, subjects like English, history, and science are mostly teacher activities, in that teachers do most of the reading, writing, talking, and thinking. Students take notes, which is a hell of an activity for training stenographers but not much good for anything else. A school is good when its activities require students to do the heavy work. Moreover, student work should have some relationship to what scholars in a particular field actually do.

*When its activities bring together students of great diversity in background and ability. There is, in fact, no evidence that "bright" children learn less when they are with "slow" children than when they are with other "bright" children. There is evidence that when children are labeled "slow", they tend to develop a bad - sometimes incurable - case of low self-esteem.

*When it moves away from valuing memorization and ventriloquizing and moves toward valuing question-asking, problem-solving, and research. This does not mean a good school forgoes all information-giving - for example, through lectures and text assignment. It does mean that a good school wants students to do as much inquiring, generalizing, and verifying as possible.

*When it moves away form valuing knowledge "for knowledge's sake" and moves toward valuing the use of knowledge in daily life. In other words, a good school comes very close to saying that if you don't act as if you know something then you don't know it.

*When it accepts as legitimate many new subjects invented, say, during the past 75 years or so - e.g., anthropology, sociology, cinematography, ecology, cybernetics, linguistics, meteorology, marine biology, musicology, futuristics, urbanology, etc. The curriculum makers of a good school are not so sure as curriculum makers used to be about what are basic subjects.

This article originally appeared in the February 3, 1980 issue of the Chicago Tribune. It is reprinted with permission of Neil Postman.

John, the Vicious Kid

Thomas C. O'Brien

I had occasion recently to write the following letter:

> Dear John,
>
> You are vicious. We love you. Keep up the good work.
>
> Sincerely yours,
> /s/
> Thomas C. O'Brien

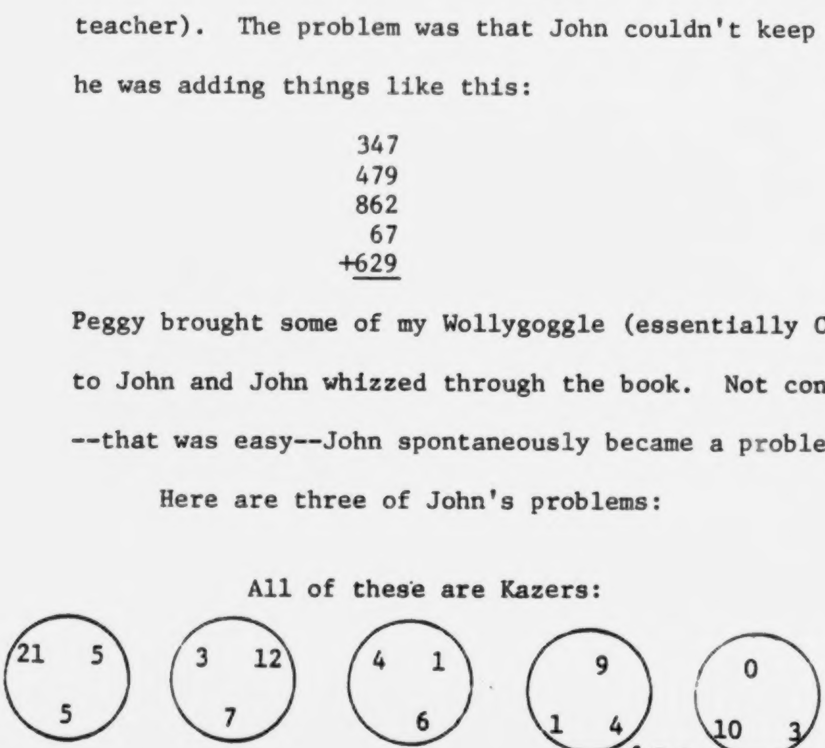
What occasioned such a letter? We've gotten to know John since getting to know his Mom, Peggy, who is a student at SIUE. John, we were told, is having difficulty with math because of carelessness (according to his teacher). The problem was that John couldn't keep his digits straight when he was adding things like this:

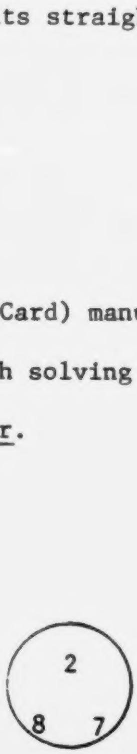
$$\begin{array}{r} 347 \\ 479 \\ 862 \\ 67 \\ +629 \\ \hline \end{array}$$

Peggy brought some of my Wollygoggle (essentially Creature Card) manuscript to John and John whizzed through the book. Not content with solving problems --that was easy--John spontaneously became a problem deviser.

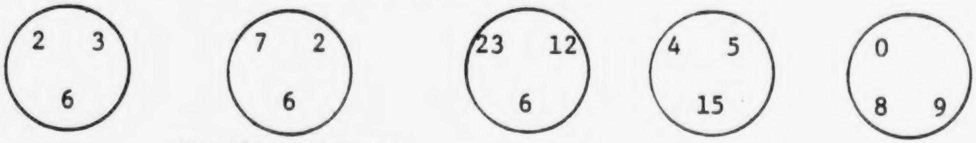
Here are three of John's problems:

All of these are Kazers:





None of these are Kazers:



What's a Kazer?

All of these are Specas:

24 45 52 17 10

None of these is a Speca:

15 19 74 1 5

What is a Speca?

Next John tried a third Creature. He came up with the following exemplars: 1, 24, 45, but he couldn't find any more exemplars. Finally he tossed the problem out to us through Peggy. The problem is this: Bultins are numbers such that the sum of the digit multiplied by the end digit yields the original number. For example 45 is a Bultin because (4+5)x5=45. Can you find another Bultin other than 1, 24 and 45?

Now do you see why John is a Vicious Kid? John, we love you.

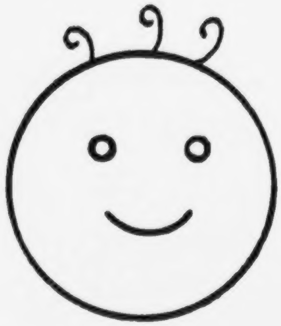
John is 11. He is a sixth grader at N. O. Nelson School, Edwardsville.

A Snapnab is a trio of numbers, any two of which add to ten.

A Speca is a number which is 3 more than a multiple of 7.

Mirrors . . .

Carol Ann Seibel



Look at me!
Smiling face
Twinkling eyes
And Gyrating Muscles
All peering back
    from my Mirrored Reflection

Give any kid (regardless of age) a mirror and it brings out the clown in you -

Give any child a mirror and watch him sit up and take notice:

1. Describe yourself in living color
2. Catch a sun beam and track its ray across the ceiling (when teacher's not looking)
3. See how far up and how far down you can explore
4. Check your teeth and the valley beyond
5. Check your neighbor's reflection
6. Sit close and check two monkeys mingling smiles -
7. Check as far up nose as possible
8. Make all halves a whole
9. See mountains and valleys in wrinkled clothes

Get the idea?

Marion Walter has written an enticing book, Make a Bigger Puddle Make a Smaller Worm which has now gone paperback through the Scholastic Book Club under the title The Magic Mirror Book. She uses half pictures and vivid partial objects to stimulate children's imaginations.

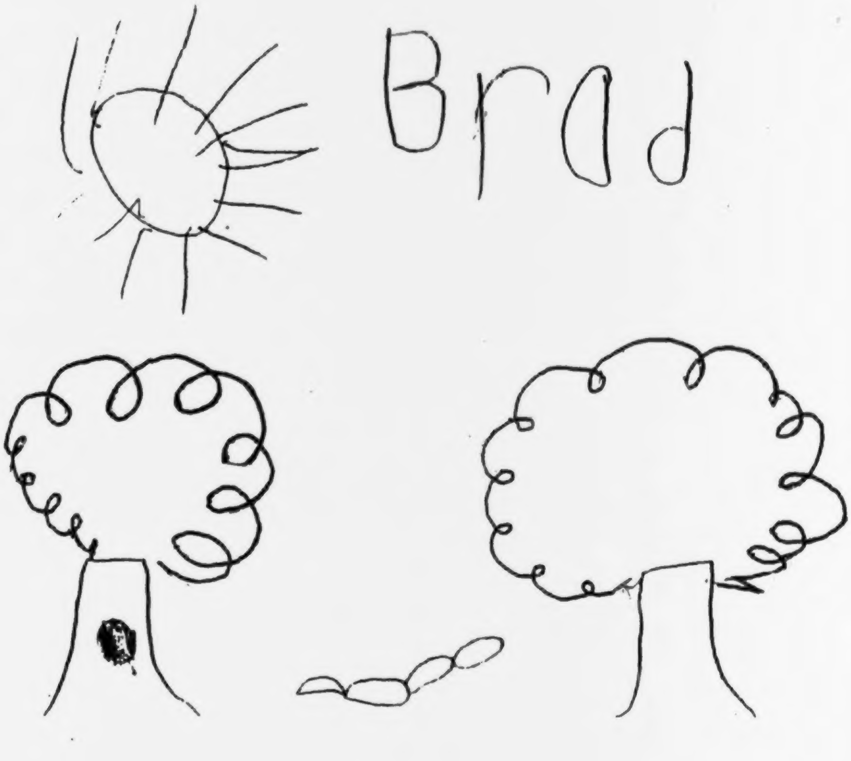
I use this book with a math group in order to explore symmetry. Some of my students began merely to angle the mirror to make the object whole. Others began to manipulate the mirror and make some very interesting designs. One page is vivid green with varied red and white partial designs. As the design reflection came into focus my students would tell tales. Super imagination! One child kept commenting on a Mexican design, and telling a story about a Mexican boy coming to the well next to the market place where the vases were sold. The boy filled the vase with water from the well because Mexican kids are very poor and don't have water in their house. The boy passed by the pine tree (image from book doubled by mirror usage). He tried to drag the tree back to his house. Both hands were filled . . .All this from a free spirit whose imagination soared.

My kids kept sliding the mirror up and down and around and about trying to get different ideas and designs for the page of colored dots. Some saw lurking animals and proceeded to discuss "firey eyeballs" and "sonic space spots".

I strongly recommend a look at The Magic Mirror Book.

The book was in constant demand. Children love to manipulate mirrors. Kids even seem to enjoy the feel of the mirror. Several times I observed some rubbing the shiny surface and then observing themselves in the mirrored surface, smiling, and raising an eye lash, blinking and noting how they were in control of their facial muscles and could change them at will, straightening out the faces, crinkling an eye, raising an eyelid, pulling mouth out --

When I asked "What do you think?" She answered, "Look how much prettier I look when I smile!" Everyone loved the book and seemed to be ham enough to enjoy his own face and the antics he could create.



A Review of Mathematics Their Way

Diane White

Mathematics Their Way by Mary Baratta-Lorton is an innovative teacher's guide to an activity-centered mathematics program for Early Childhood Education. Without textbooks for the children, she has devised an organized sequence of learning activities which lead children to the discovery of patterns and relationships in their environment. Her methods include (among others): free exploration of materials, a search for pattern, and interaction with the environment. Her suggested materials are "hands on" concrete items that are common to and/or collected by children. Her stated goals for each chapter have two parts -- those concerning math skills and concepts and those concerning social skills and concepts. In the following review I will be referring to the contents of the Introduction, Chapter 1 and Chapter 2.

As is made evident by the lack of student texts and ditto masters for math problems, Mathematics Their Way is an entirely activity-oriented approach to learning. This interaction with the environment involving physical, concrete experiences, is applauded by Eric Lunzer in the transcript "A Researcher Talks To Teachers and Parents." He feels that interactions of this sort allow discoveries by children which lead to their intellectual development. Baratta-Lorton gives examples of numerous activities in each chapter. Some of these are group oriented; others are individually geared. She maintains the continuity of the concept throughout the chapter while providing a variety of approaches to the goal. Her viewpoint is consistent with that of Edith Biggs and James MacLean who point out in Freedom To Learn (p.55) that "The essence of active learning is variety: Variety in approach, in the interaction of children, and in the experiences provided for individual children."

Baratta-Lorton sees free exploration as a very important part of mathematics. In fact, she devotes the first chapter to just this. According to Molly Brearley in The Teaching of Young Children (p. 39), "...children need to explore materials before they can go on to express their representations through them..." Baratta-Lorton's numerous free exploration activities in Chapter 1 encourage and provide numerous opportunities for the children to explore the potentials and limitations of many materials before they are asked to work with them in suggested ways.

The search for and understanding of pattern is also an important part of Mathematics Their Way. Herbert Ginsburg suggests in Children's Arithmetic: The Learning Process (p.9) that "Children search for meaning. Children try to make sense of the world by looking for an underlying pattern, for deepter meaning." Baratta-Lorton puts this natural interest in patterns to use in Chapter 2 by having the children explore pattern through rhythm activities, people row patterns, unifix cubes, geoboards, and the like. The suggestions are plentiful but are offered with the intention that the teacher will use them as a springboard, allowing students to expand on ideas that greatly interest them.

Some of the beautiful aspects of Barrtta-Lorton's approach are: 1) the activities are open-ended, 2) there are no right or wrong answers, and 3) the activities encourage divergent thinking. It is assumed that children have valid problem solving thought processes and shouldn't be railroaded into one acceptable pattern of thought. This is the stand that Hassler Whitney takes in the transcript "Can Children Remain Themselves in the Classroom?" Baratta-Lorton then takes this quality of divergent thinking one more step, into the area of social-emotional skills. She lists that being able to observe values of "many different, equally valid approaches to a problem, and experiencing that one's own value is not diminished if others are valued as well" are goals that are just as important as mathematical concepts. This is supported by Herbert Ginsburg in Children's Arithmetic: The Learning Process on page 71 where he states, "You do not need to make a choice between children's intellectual growth and their social-emotional development." Throughout Mathematics Their Way this point is illustrated. Each chapter is headed by an equally long set of social concepts and math concepts to be gained.

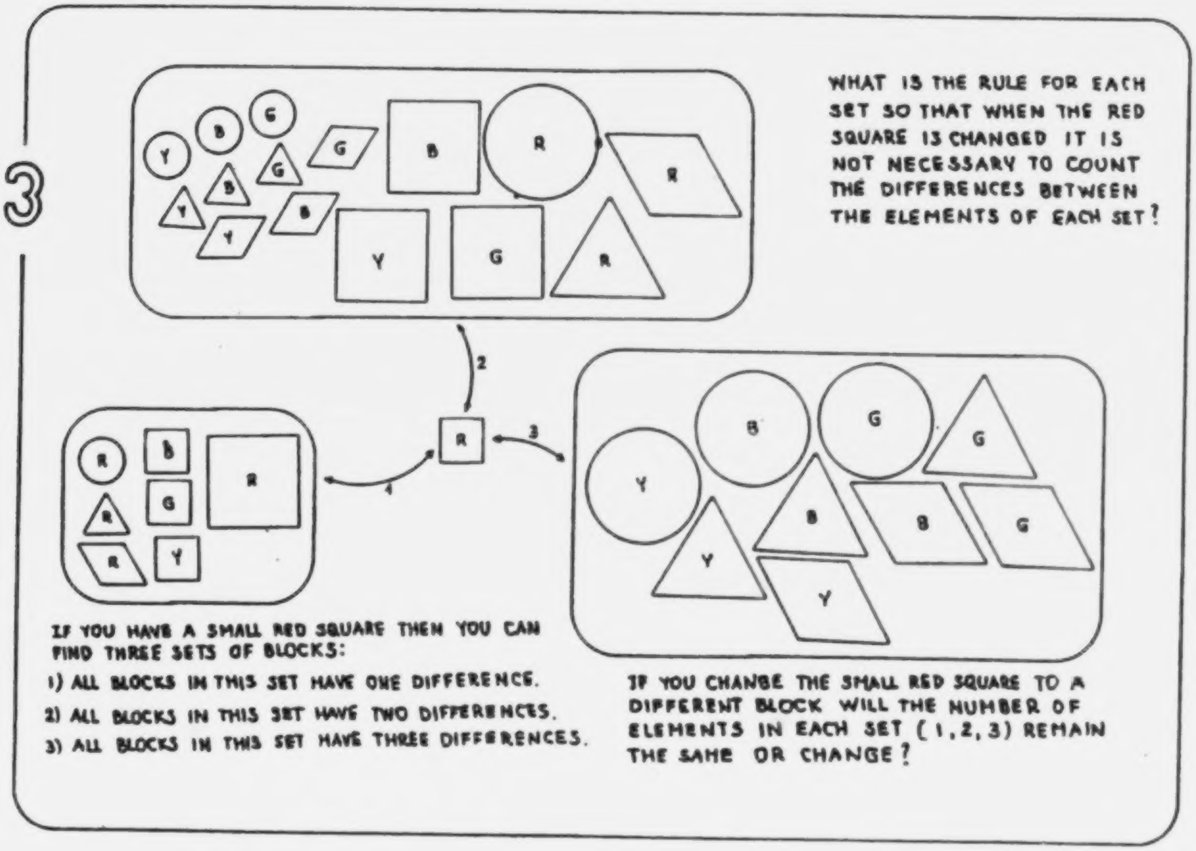
Materials, of course, play an important part in an activity-centered learning process. All of the materials suggested in Mathematics Their Way are of the hands-on sort. The author's activities for children have them working with pegboards, beads, geometric shapes, ceramic tiles, geoboards, scales, pattern blocks, junk boxes, beans, and cubes to name a few. David S. Fielker, editor of Mathematics Teaching , applauds these types of learning materials in the transcript "Teachers, Elementary Schools, and Geometry." The fact that Mary Baratta-Lorton often suggests that students bring in objects from home is also noteworthy. This further links the learning experienced within the school, with the ome and other real-world environments. Herbert Ginsburg stresses this fact in Children's Arithmetic: The Learning Process on page 70 where he writes, "So exploit the ordinary environment in which children live. Recognize that fancy educational toys are not necessary; children can learn instead from card games and sticks and shopping."

In compiling this manual, Mary Baratta-Lorton has kept the child and his needs in mind. This book is not only activity-centered, but also child-centered. The framework is presented in Mathematics Their Way for a potentially successful math program for young children. It is still to be remembered, however, that it has to be the teacher who makes it all happen. It is the teacher who provides the environment, which in turn fosters creativity. The class needs to be filled with a non-threatening air of discovery. Children should feel free to follow their urges of exploration, using materials which are interesting, and approaches which vary. This type of situation is favored bv Eric Lunzer in the transcript "A Researcher Talks to Teachers and Parents." He feels that learning can be a pleasant activity if done on a play-learning basis. Mary Baratta-Lorton has relieved the students who are taught via Mathematics Their Way of the drudgery which is often attached to learning math through solely conventional rote learning. She has provided a means for intellectual as well as social growth in such a manner that children will be encouraged to continue their learning quests.

MATHEMATICAL ACTIVITIES FROM POLAND II

Jerzy Cwirko-Godycki

Here is a sampling of activities from Jerzy's new Teachers' Center publication, Mathematical Activities from Poland II. The book is available from the Teachers' Center Project at the cost of printing, $1.00. Jerzy, a Visiting Scholar with us during the spring of 1980, is a Fellow of the Institute of Pedagogical Research, Warsaw.



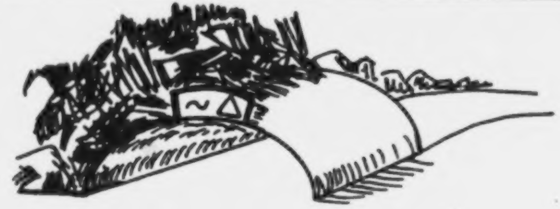
WHAT IS THE RULE FOR EACH SET SO THAT WHEN THE RED SQUARE IS CHANGED IT IS NOT NECESSARY TO COUNT THE DIFFERENCES BETWEEN THE ELEMENTS OF EACH SET?

IF YOU HAVE A SMALL RED SQUARE THEN YOU CAN FIND THREE SETS OF BLOCKS:

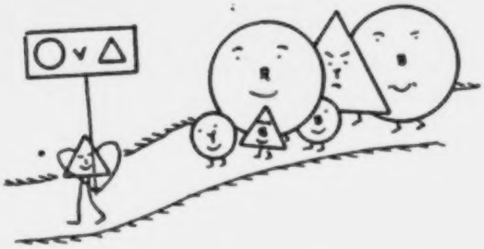
1) ALL BLOCKS IN THIS SET HAVE ONE DIFFERENCE.
2) ALL BLOCKS IN THIS SET HAVE TWO DIFFERENCES.
3) ALL BLOCKS IN THIS SET HAVE THREE DIFFERENCES.

IF YOU CHANGE THE SMALL RED SQUARE TO A DIFFERENT BLOCK WILL THE NUMBER OF ELEMENTS IN EACH SET (1, 2, 3) REMAIN THE SAME OR CHANGE?

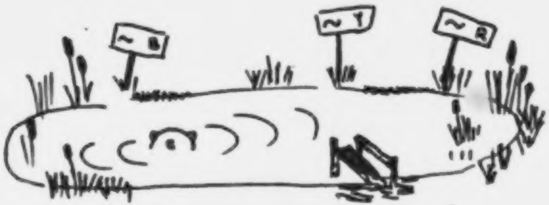
6



WHICH SHAPES CAN GO THROUGH THE TUNNEL?
CHANGE THE SIGN AND ASK SIMILAR QUESTIONS.

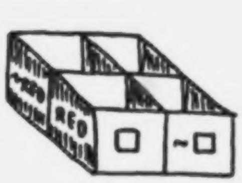


WHAT OTHER BLOCKS CAN JOIN THE PARADE?
CHANGE THE SIGN AND ASK SIMILAR QUESTIONS.

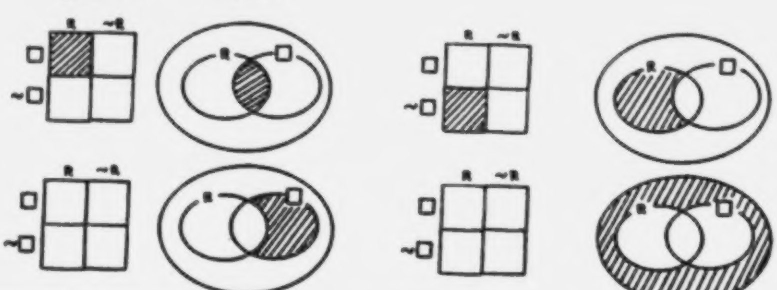


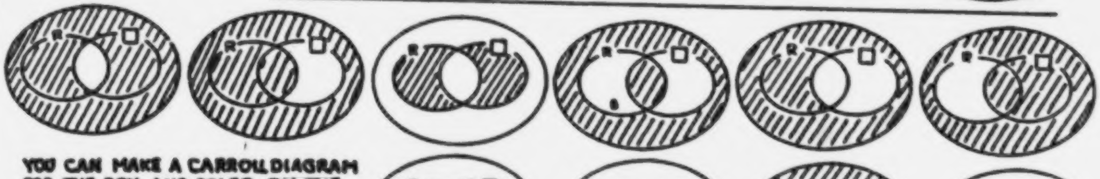
WHICH BLOCKS CAN GO SWIMMING?
CHANGE THE SIGN AND ASK SIMILAR QUESTIONS.

8

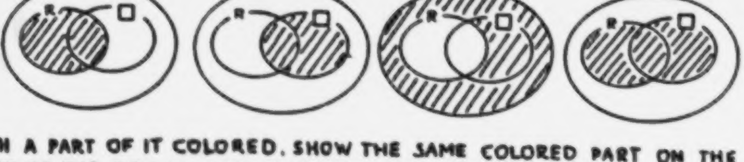


CARROLL VENN





YOU CAN MAKE A CARROLL DIAGRAM FOR THE BOX AND COLOR ON THE DIAGRAM THAT PART THAT INTERESTS YOU ABOUT THE BOX (E.G. RED AND SQUARE).
YOU CAN SHOW THIS ON THE VENN DIAGRAM ALSO.



USING THE VENN DIAGRAM WITH A PART OF IT COLORED. SHOW THE SAME COLORED PART ON THE CARROLL DIAGRAM. WHAT PART OF THE BOX IS REPRESENTED ON THE DIAGRAM?
CHANGE EACH OF THE VENN DIAGRAMS TO CARROLL DIAGRAMS.

Name Game

Carole Von Hoven

This is an activity that works well with a small group or the class as a whole. Working in a small group of children, they write down and one of their classmates' names. They then make up questions whose answers come from the letters in that name. After a number of questions are written, the puzzle can be presented to the class to work. Individuals can make up questions for their own name also.

My children really enjoyed the activity because it involved someone they were close to.

Toni Kelly

1. a heavy weight _ _ _
2. opposite of off _ _
3. give you permission _ _ _
4. single; a number _ _ _
5. used to unlock a door _ _ _
6. to say something _ _ _ _
7. a loud shout _ _ _ _
8. to murder _ _ _ _
9. sick _ _ _
10. to tell a fib _ _ _

Robinson

1. father's boy child _ _ _
2. to steal _ _ _
3. a bird _ _ _ _ _
4. opposite of out _ _
5. beginning of life _ _ _ _
6. to do something wrong _ _ _
7. opposite of yes _ _
8. what a ghost says _ _ _

Jerzy's

Math

Problems

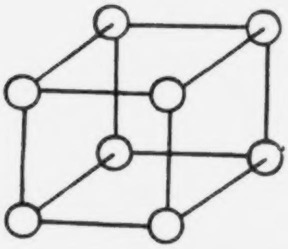
Dice Problems

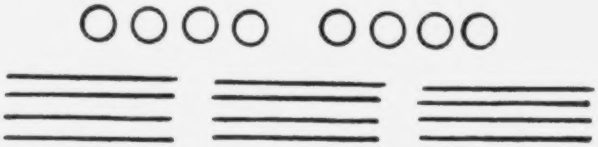
Jerzy Cwirko-Godycki

A die is a very simple manipulative device that may be used to teach math in the classroom. Because of the die's simplicity a child is able to concentrate on the rules of the game rather than on the material itself. You can devise other problems for classroom use. Other dice-problems can be found in Mathematical Activities From Poland (A SIUE Teachers' Center Project Publication, 1979). In this publication are other dice problems that can aid in a child's development of spatial relations.

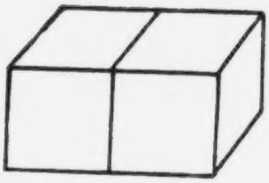
1. The Skeleton of a Die

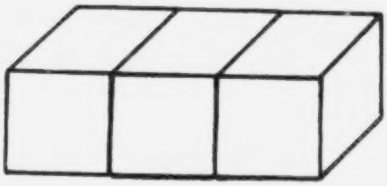
The skeleton of a die or cube can be arranged by using 8 balls and 12 sticks. (Matches and plasticene may be used.)

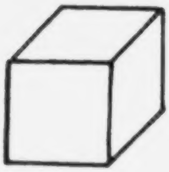


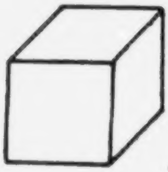


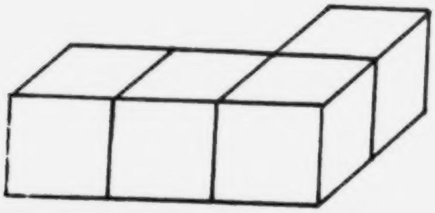
How many balls and sticks are needed to construct each of these skeletons?

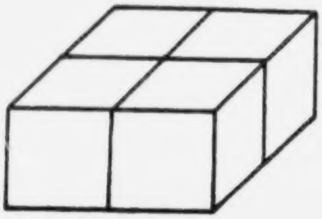


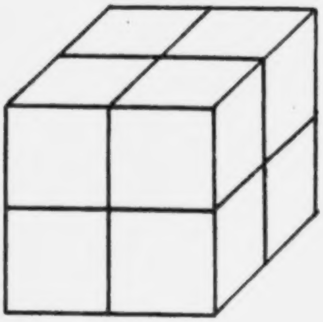


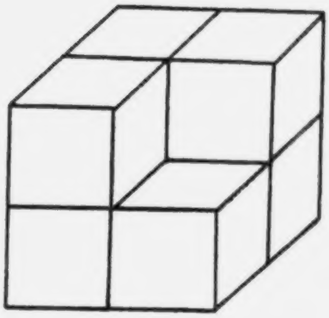


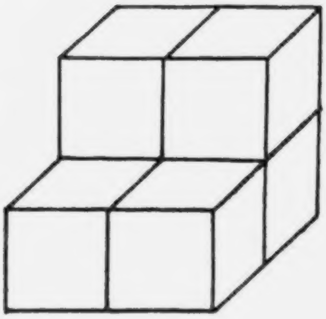








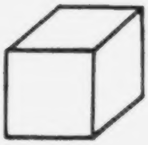


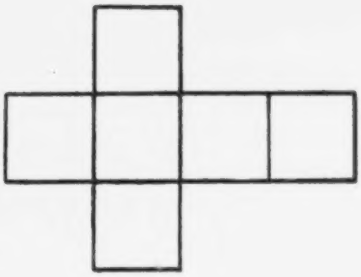


What is the shape of the solid consisting of 4, 5, 6, 7, or 8 cubes using the smallest number of balls and sticks?

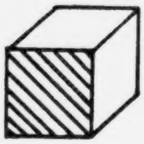
2. Colored Cube

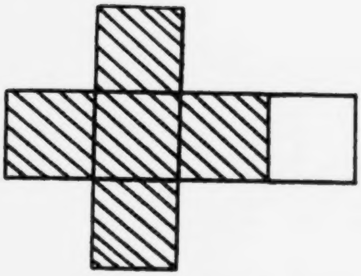
Using 1 color the result is a single-colored cube.

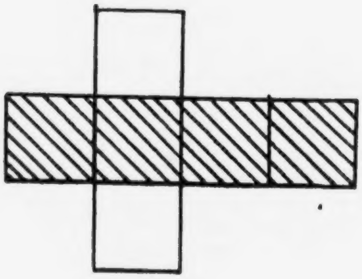


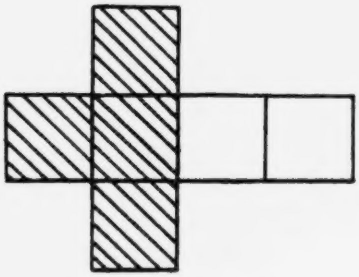


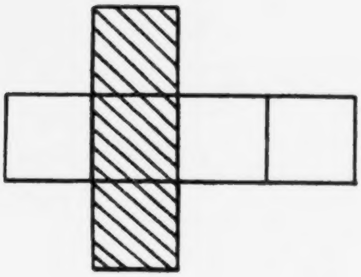
Using 2 colors the result is a variety of colored cubes.

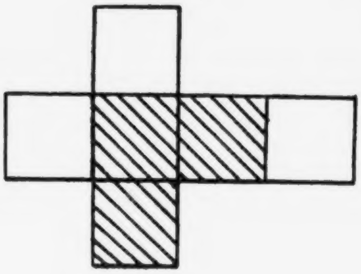


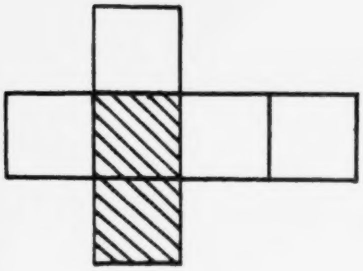


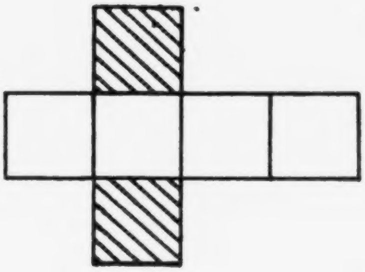


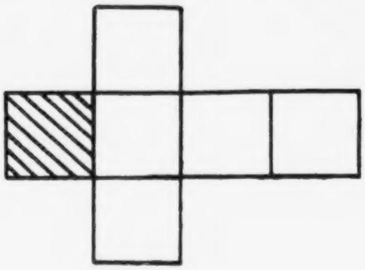








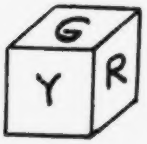


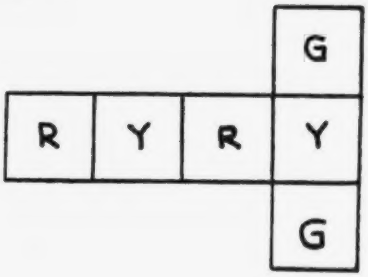


How many different cubes can you make using 3, 4, 5, or 6 colors?

Note: Be careful with the left-handed and right-handed die.

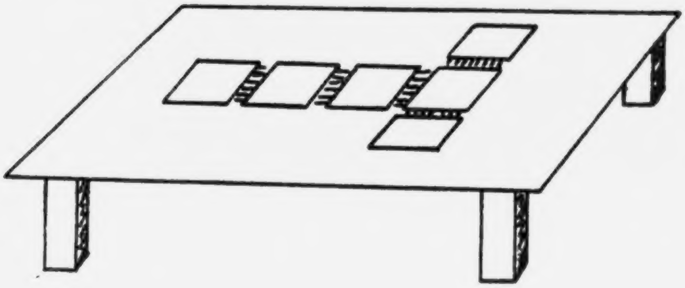
3. Tri-Colored Die





The opposite faces of a die have the same color.

1. Construct a net from a die on a flat surface such as a table without detaching any of the squares.



2. Explore the different kinds of nets that result in a cube. Again, do not detach the squares.

3. What can be said about the order of colors of such nets?

Note: The squares of the net can be temporarily fastened by using such devices as velcro or snaps.

The children may find these rules about their net construction:

Y	R	Y	R

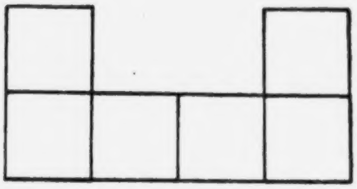
The colors appear in pair alternates.

Y	
R	G

Three adjoining faces (in one point) must have three different colored faces.

Is this enough information to construct a die from the net?

The children can try to construct dice from their nets; they will find that they need another rule. Maybe they will tell you that "the net can't have teeth" - this is the third rule!



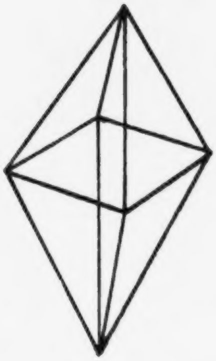
* * *

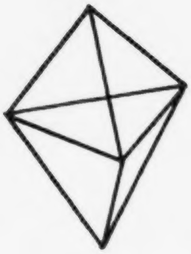
Now that the children have discovered the three rules, see if they can apply the rules in coloring the blank nets so that they are able to determine if the net is "good" or "wrong".*

After determining the "good" nets, the children can determine if their decision was good by constructing a cube with the materials using the nets as a guide.

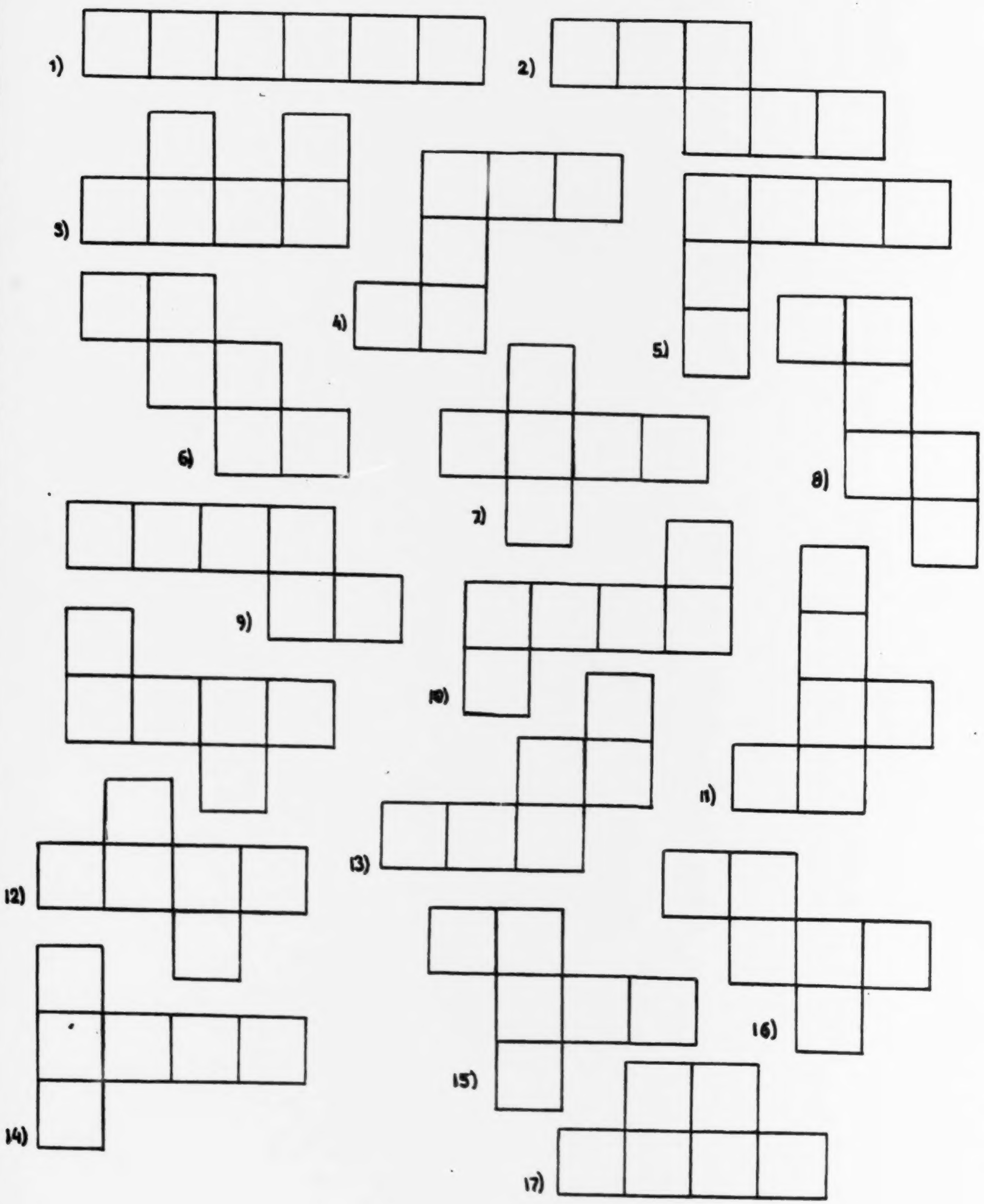
* * *

Similiar questions may be asked about other solids like these:

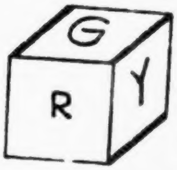




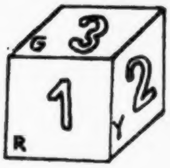
*A "good" net is one that makes a cube: a "wrong" net is one that doesn't make a cube.


1)
2)
3)
4)
5)
6)
7)
8)
9)
10)
11)
12)
13)
14)
15)
16)
17)

4. Die-Coding

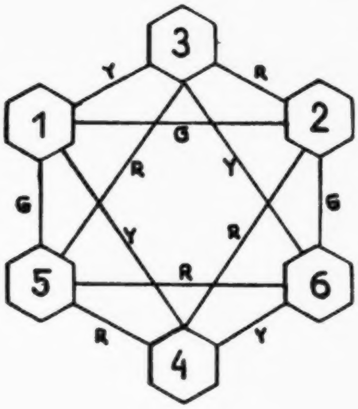


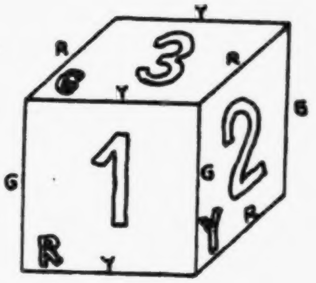
Edges that connect the opposite faces of the same color are the same color as those faces



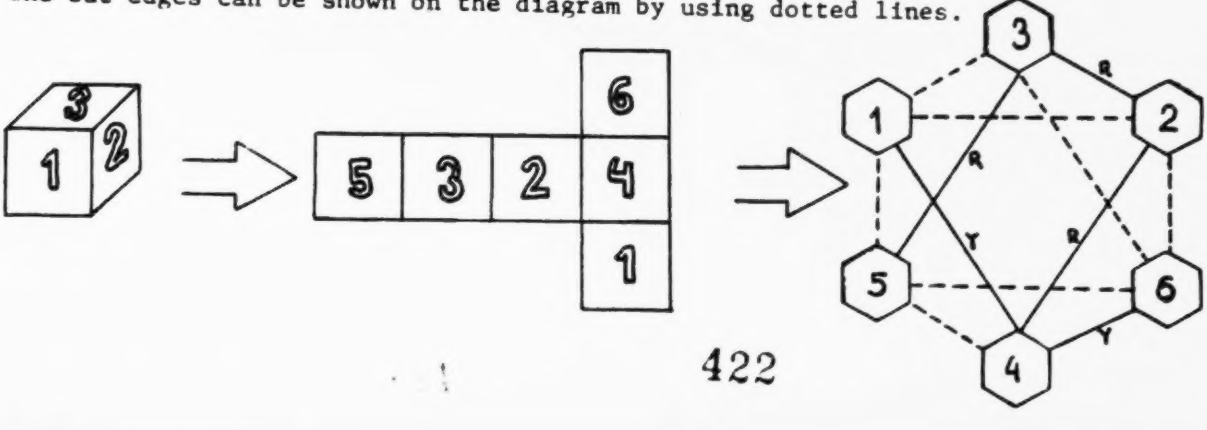
The faces are numbered (1-6) so that the sum of the opposite faces equals 7.

By using the following diagram, a die can be coded. (Colored lines may make it easier to see the relationships.


3
Y
R
1
2
G
R
Y
G
G
Y
R
5
R
6
R
Y
4

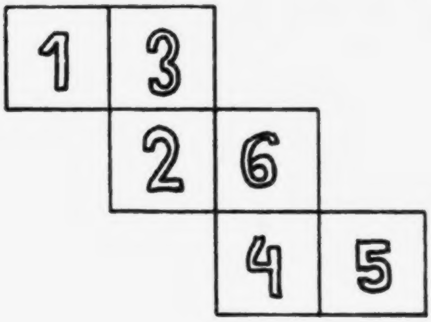

Y
R
3
R
G
Y
G
1
2
G
G
R
Y
R
Y

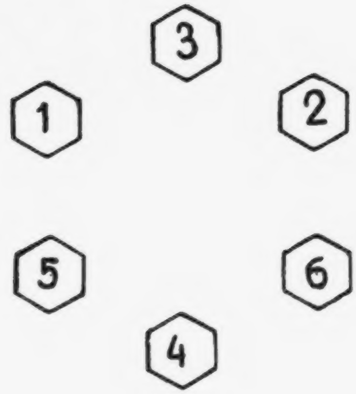
If you have a cube in order to make a net some of the edges must be cut. The cut edges can be shown on the diagram by using dotted lines.


3
1
2
6
5
3
2
4
1
3
R
1
2
R
Y
R
5
6
Y
4

More questions may be asked.

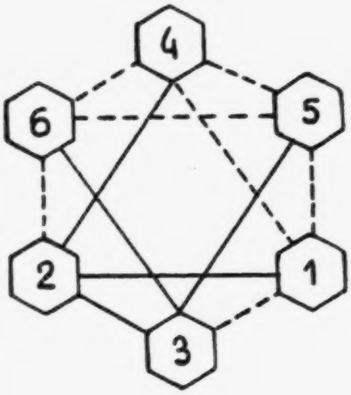
1.





If you have a net like this, show the cutting lines on the diagram.

2.



If you have a diagram like this (dotted lines showing cut edges) make the net.

* * *

1. How many edges on a cube are red? green? yellow?
2. How many edges meet in the corner of the cube?
3. How many edges are perpendicular to each face?

4. How many edges must be cut to make a net?

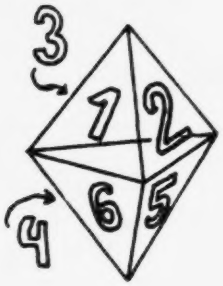
5. How many edges must be adjoined on the net?

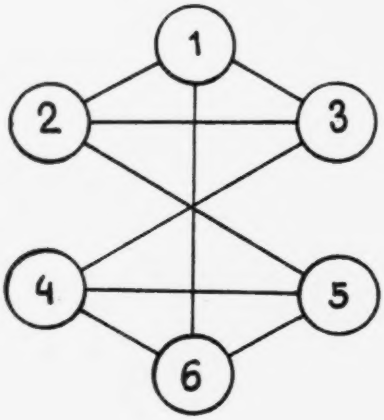
6. How many edges of the net must be adjoined to make a cube?

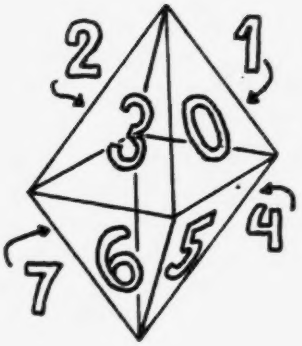
7. Is it possible to have four un-cut red edges on a net?

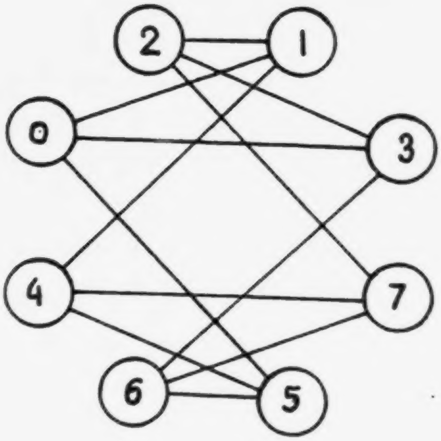
* * *

Try to prepare similiar problems for solids and their corresponding diagrams.

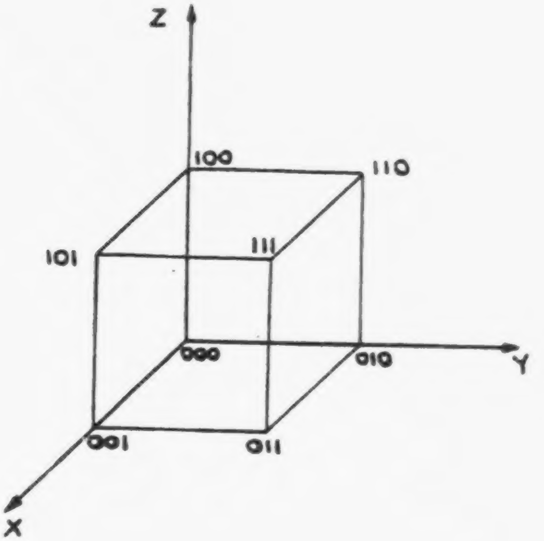








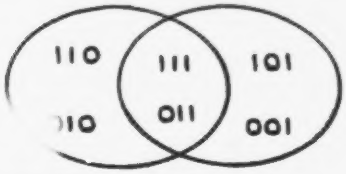
5. The Binary Coding


Z
100
110
101
111
000
010
Y
001
011
X

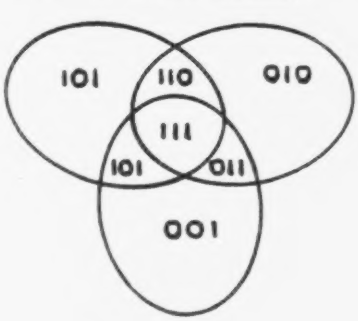
1. A face is defined as a set of four corners:

$$\{000, 010, 100, 110\}$$

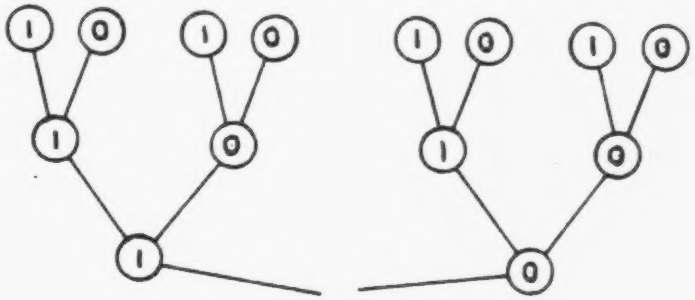
2. An edge is defined as an intersection of two faces:


110
111
101
010
011
001

3. A corner is defined as an intersection of three faces:


101
110
010
111
101
011
001

The opposite corners of a cube can be found by using a tree.


1
0
1
0
1
0
1
0
1
0
1
0
1
0

The opposite branches of the tree show the opposite corners of a cube.

. . . . . .

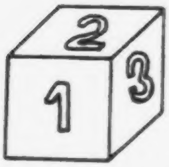
100 —— 100

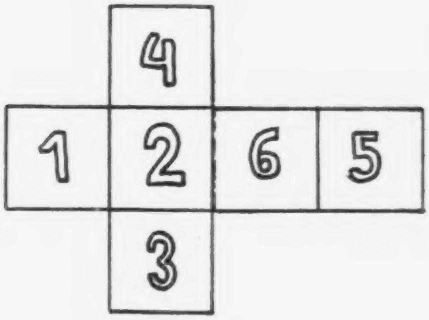
000 —— 111

Find the remaining edges, faces, and opposite faces.

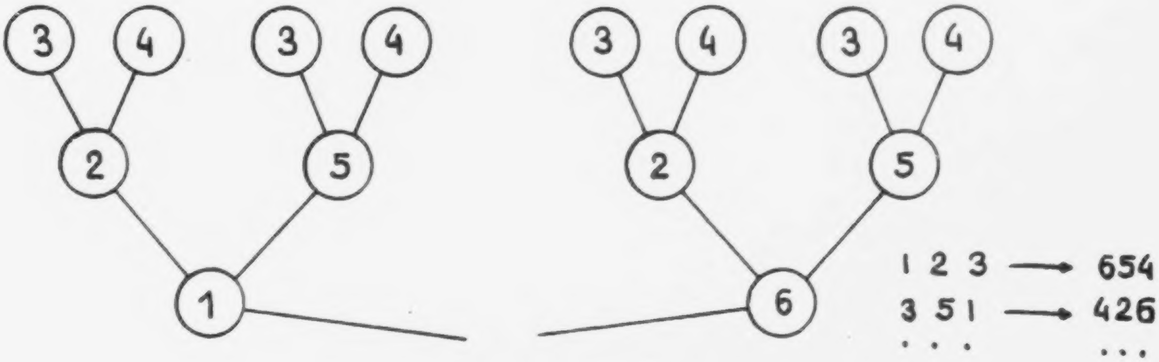
* * *

Ask similiar questions about this die (coded in a different way).



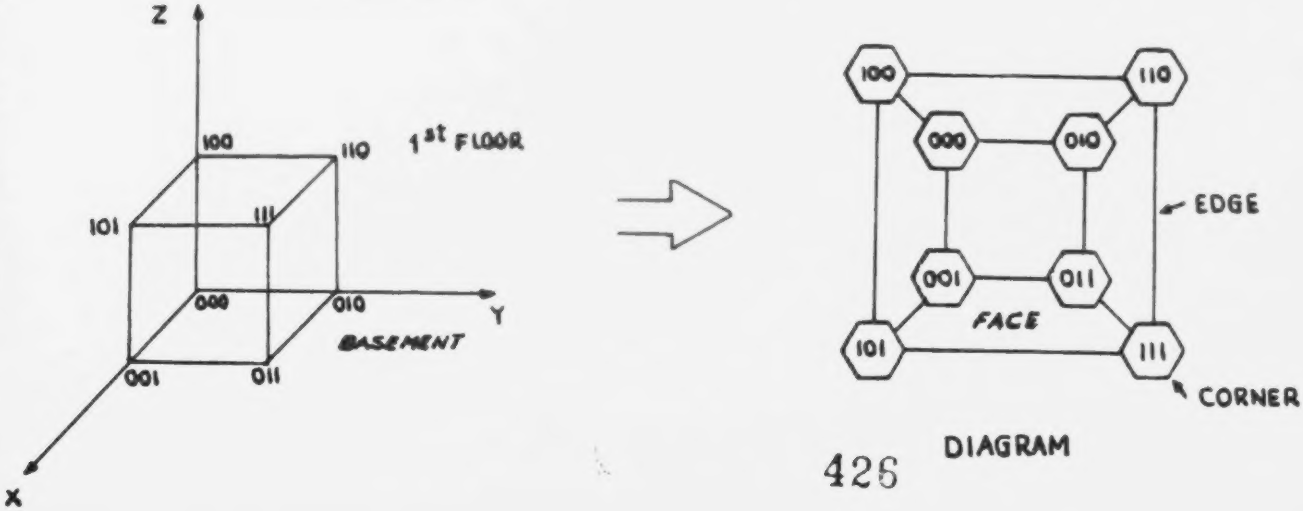


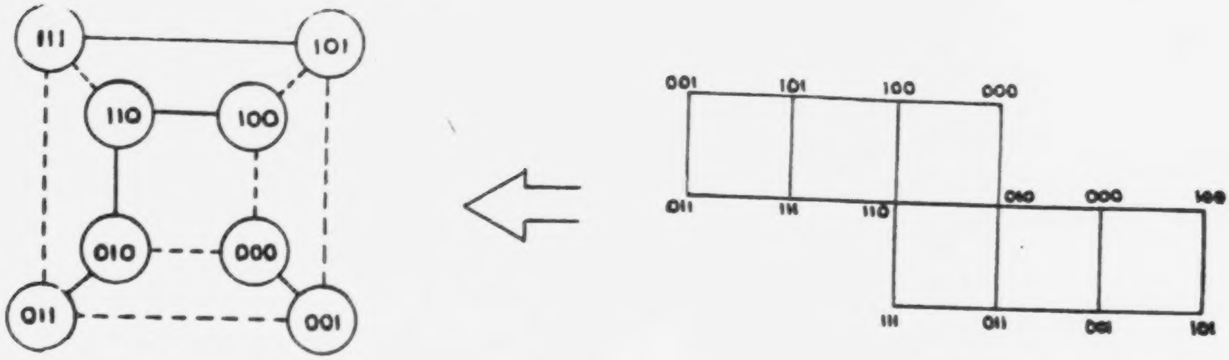
The tree may be similiar to this one.

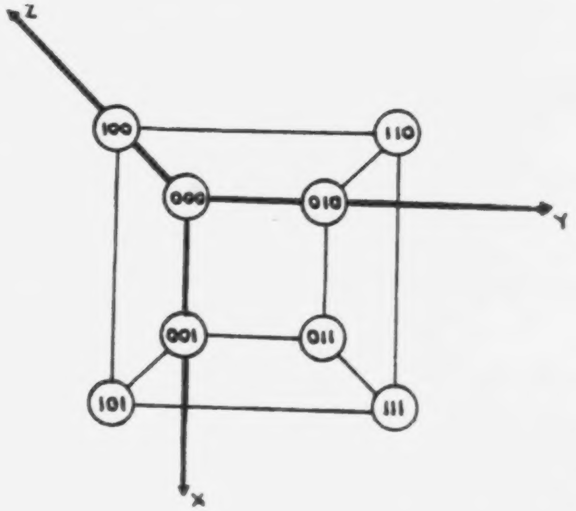

3
4
3
4
2
5
1
3
4
3
4
2
5
6
1 2 3 → 654
3 5 1 → 426
. . . ...

What other questions may be asked?

6. Another Die Coding

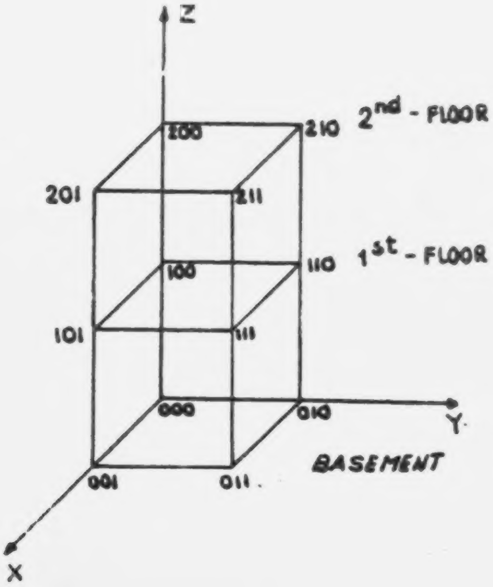

Z
100
110
1st FLOOR
101
111
000
010
Y
BASEMENT
001
011
X
100
110
000
010
EDGE
001
011
FACE
101
111
CORNER
DIAGRAM

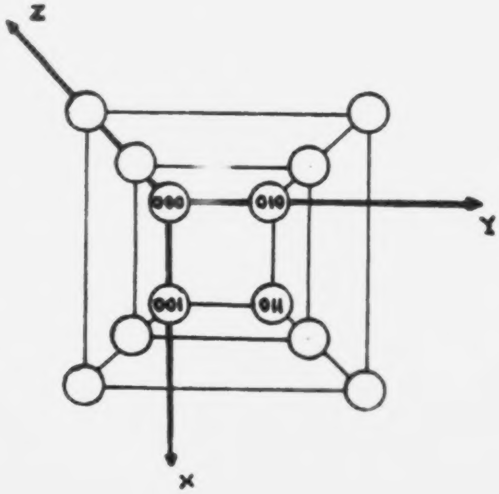

111
101
110
100
010
000
011
001
001
101
100
000
011
111
110
010
000
100
111
011
001
101

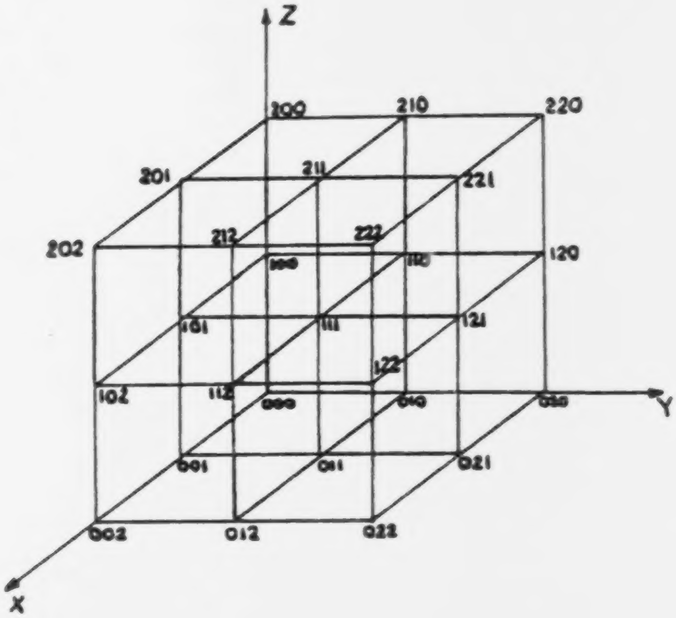

Z
100
110
000
010
Y
001
011
101
111
X

It looks like an elevator shaft.

If you can use numbers from Base Three you can code up to the 2nd Floor.


Z
200
210
2nd - FLOOR
201
211
110
1st - FLOOR
100
101
111
000
010
Y
001
011
BASEMENT
X


Z
000
010
Y
001
011
X


Z
200
210
220
201
211
221
202
212
222
120
100
110
101
111
121
122
102
112
000
010
020
Y
001
011
021
002
012
022
X

Find these points:

000
001
002
010
011
012
020
021
022

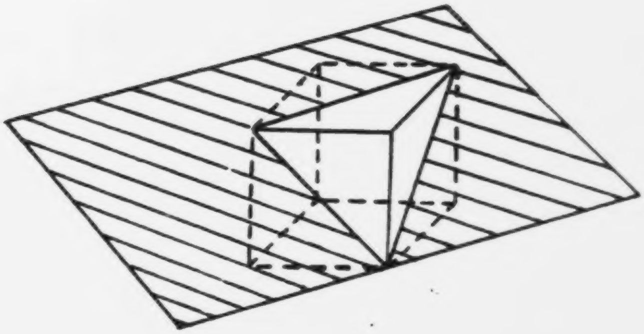
100
101
102
110
111
112
120
121
122

200
201
202
210
211
212
220
221
222

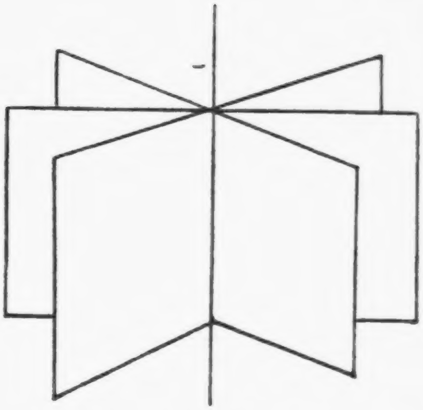
Other questions may be asked using the notations in Base Three.

7. A Pencil of Planes

Cutting a cube using a plane you can get different figures.

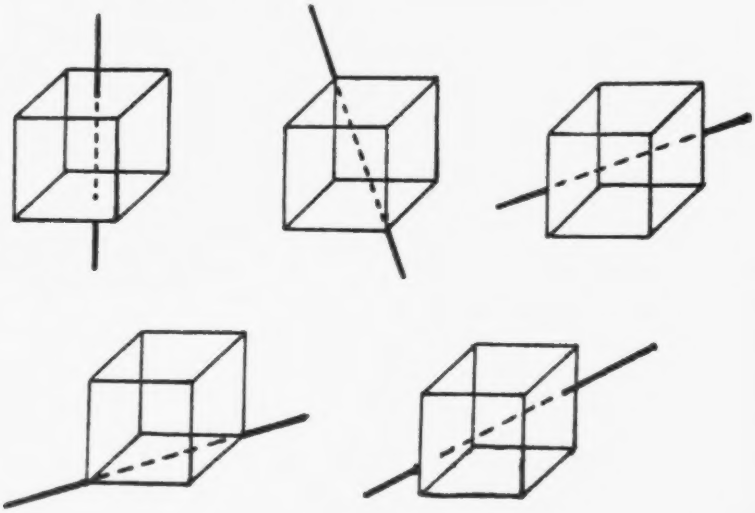


You can cut potato cubes or a cube from styrofoam.

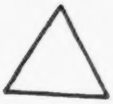
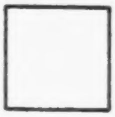
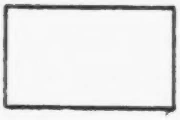
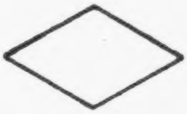
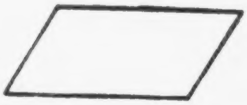
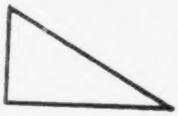
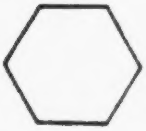
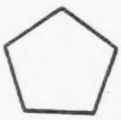
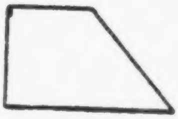
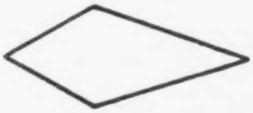
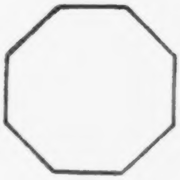
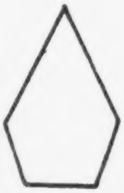


Pencil of Planes

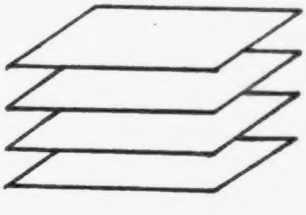
What figures can you get when the axis of a pencil of planes runs as it is shown in the pictures?



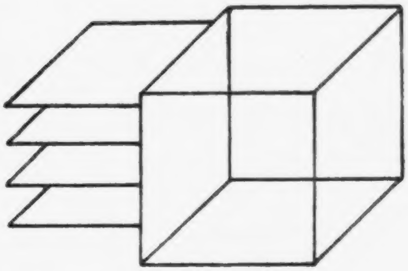
Can you get these figures by cutting the cube with one of the planes from the pencil of planes?

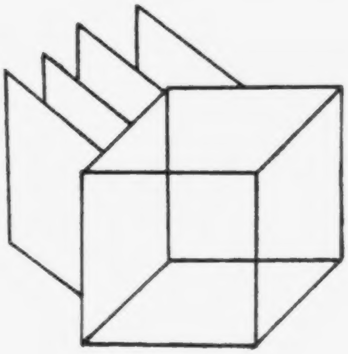













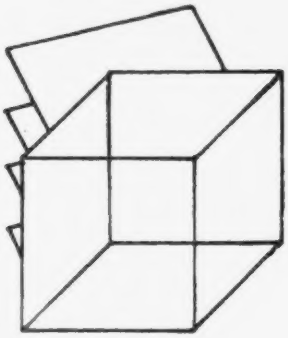
8. A Family of Planes



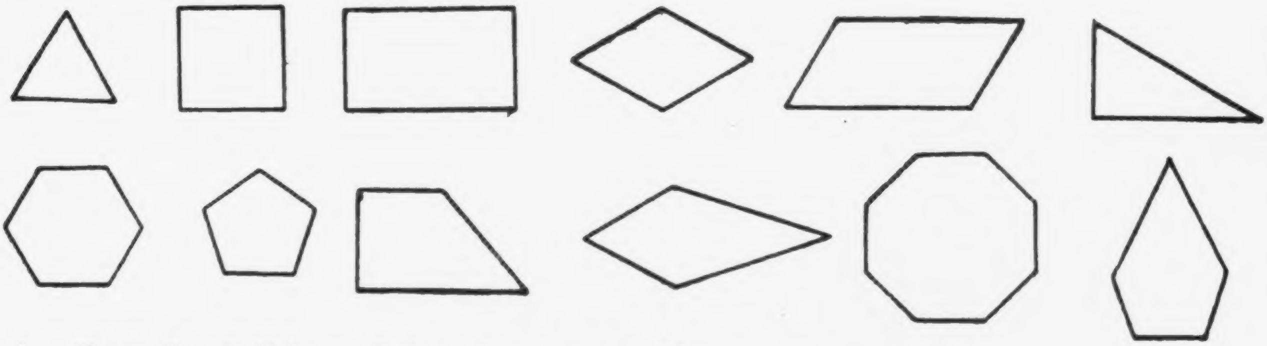
What figures can you get when the family of planes runs as it is shown in the pictures?



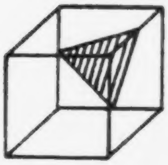


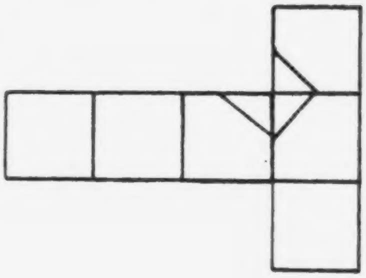


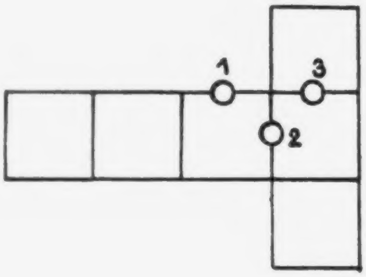
Can you get these figures by cutting the cube with one of the planes from the pencil of planes?

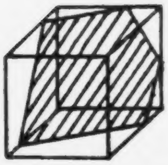


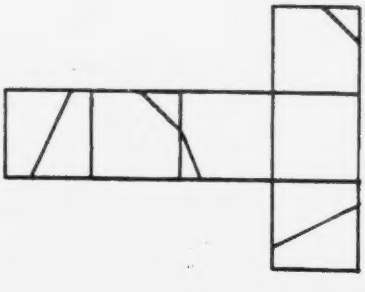
Three Non-Collinear Points Intercept a Plane

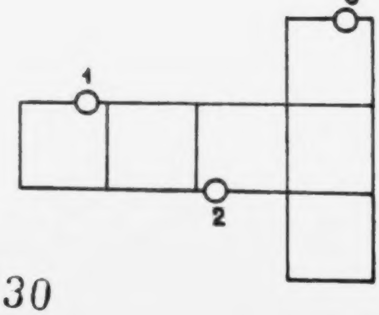




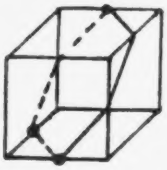


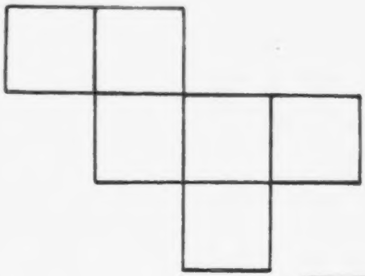


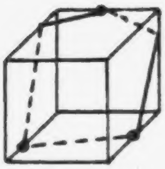


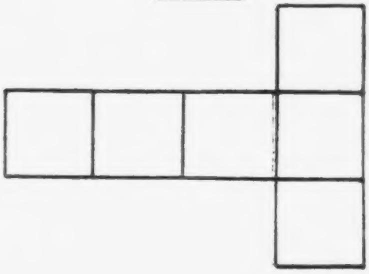


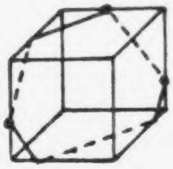
A) Mark the three points on the net.

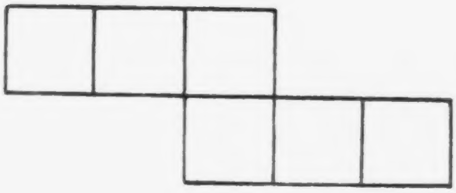




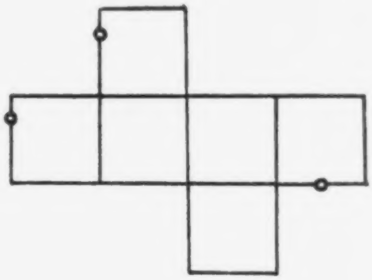


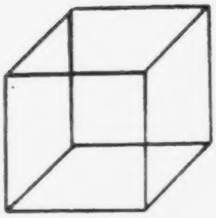


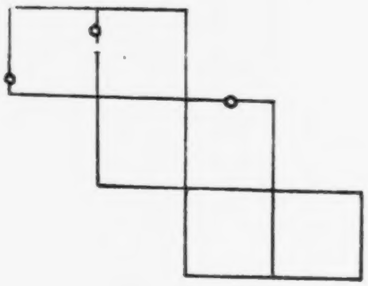


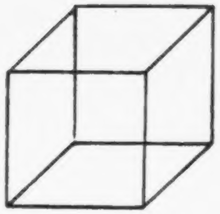


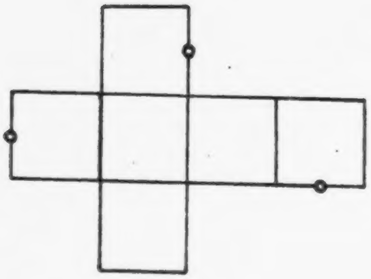
B) Draw a plane when you know the three points.

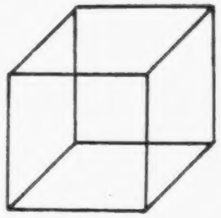




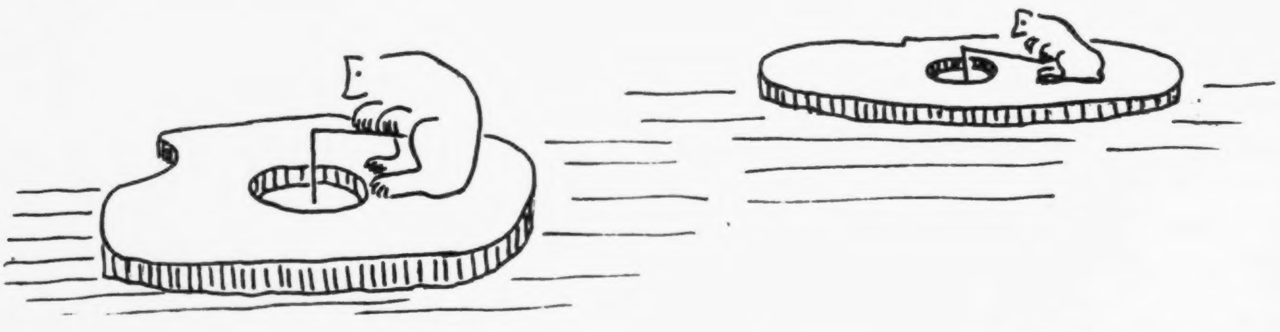








10. A Polar Bear Joke

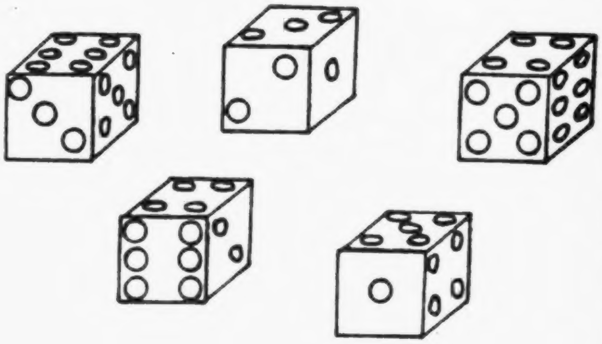


The North Polar Bears are fishing.

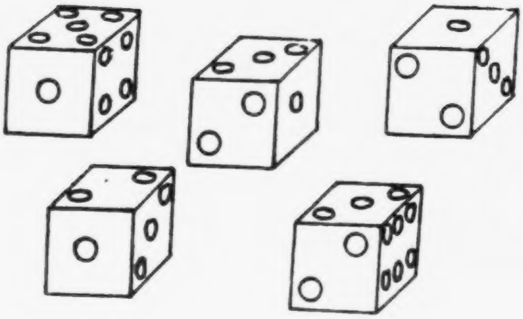
The question is "How many bears are fishing?"

You throw five dice:

For this throw the answer is six.



For this throw the answer is eight.



A) If you haven't figured out how to answer the question, maybe I can "help you". The possible answers could be: 0, 2, 4, 6, 8, 10, 12, 14, 16, 18, and 20.

B) If you still haven't figured out how to answer the question I can "tell you" that the possibilities are:

Bears	Chance
0	0.1317
2	0.1646
4	0.2469
6	0.1852
8	0.1466
10	0.0721
12	0.0367
14	0.0116
16	0.0039
18	0.0006
20	0.0001

If you know how to answer the question try to explain A and B.

* * *

Scatterers

Lorraine Allison
Douglas School
Belleville, Illinois

Elizabeth Anderson
Southern Illinois University
Edwardsville, Illinois

Dianne Anthony
Maplewood School
Cahokia, Illinois

Joan Barnes
Jerome School
Cahokia, Illinois

Bobby Bean
Park School
East St. Louis, Illinois

Jewel Birge
Slade Elementary School
East St. Louis, Illinois

Bill Breden
Jerseyville West Elementary School
Jerseyville, Illinois

Anna Breeden
Scott School North
Scott Air Force Base, Illinois

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The New York Times
New York, New York

Shirley Casey
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Sue Crowe
Jerome School
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Lois Daesch
Jefferson School
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Jerzy Cwirko-Godycki
Teachers' Center Project
Southern Illinois University
Edwardsville, Illinois

Jeanne Edgar
West Junior High School
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Fred Habermehl
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Garfield Elementary School
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Helen Miller
Logan School
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Editing and Production

The editing of SEEDBED 5 was largely done by Shirley Casey. Responsible for the typing were Sharon Smith, Ann Uram, and Theresa Ryan.

SEEDBED

Number 6

August, 1980

Teachers' Center Project
Southern Illinois University
at Edwardsville

INTRODUCTION

This SEEDBED (our sixth) had its beginnings in 1972 at the Second International Congress on Mathematics Education, Exeter. It was there that I met Professor dr. Hans Freudenthal, director of the Dutch project, IOWO, and it was there that I got to see, first-hand, something of the organic approaches to math education taken by the Britons, especially those of the Association of Teachers of Mathematics.

That five day contact with IOWO and ATM has flourished until this day, I am happy to say, via continuing visits and an intermixing of ideas (resulting in quite a large number of publications) which has been fruitful and profoundly enjoyable.

While IOWO and ATM are different in organization -- IOWO is government supported and ATM's benign anarchy is membership supported -- and while IOWO and ATM differ in the details of their day-to-day operations (to say nothing of cultural differences from Holland to UK, differences in national schooling policies and procedures, and differences in the underpinnings of education in the two nations) IOWO and ATM share several vastly important attributes: Both are passionately concerned with the well-being of children, both are organic rather than mechanistic, and both are honest and caring in their work.

It has long been my opinion, widely voiced, that IOWO and ATM are two of the most thoughtful, most well-based and most successful (what's the word -- projects/organizations/institutions?) organisms in the world of education.

It was with great pleasure, then, that I learned of Ed de Moor's and Bob Jeffery's acceptance of my invitation to participate in the Ninth Annual Summer Course. Ed has long been a curriculum developer with IOWO and Bob has been Chairman of ATM. More important, both Ed and Bob are marvelously rich and able and thoughtful (institutional affiliations aside). What firepower to make available through the Teachers' Center!

At this writing, the summer course is history by three days. The course was an utter delight!

Knowing that de Moor's and Jeffery's ideas were too good to be kept local, I asked them to prepare something which would convey something of the spirit of the summer course and, of course, of their ongoing thinking, which we could share with the many people who, because of time or geography or funds, could not participate in person.

This SEEDBED, then, is almost certainly doomed to failure--first, because experiences lose some life when committed to print and, second, because the course was too rich to be successfully conveyed in such a small volume as this. Yet there was no choice but to convey Ed and Bob in print. The voices and the good humor and the body language are missing but the ideas are here.

The first paper, by Jeffery, is an informal position paper and a sort of diary. The second consists of two problem sets by de Moor. The third is a position paper I've done, soon to be published by NIE.

Perhaps you'll gain some feeling for the spirit of our course. I suspect that you will see the fabric that Ed and Bob are/have/grow. And I think that you'll get a feeling for the potential richness of dipping beyond one's own local--school/school system/city/state/nation--borders in the construction of ideas--and more important, underpinnings--in this vital affair called education.

One of the main aspects of the course was Bob's idea of "bending." To "bend," you take an idea or an activity (or, in fact, a point of view) and you make it your own. You act on it. You fight with it. You elaborate on it. You extend it. This SEEDBED is for bending.

Join Ed and Bob and me in our profound belief that Knowledge is not a spectator sport.

Tom

Thomas C. O'Brien

Edwardsville, Illinois/5 August 80

THE SEEDS

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Maria Grey College
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Using Tables In Math Education 45
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Instituut Ontwikkeling Wiskunde Onderwijs
Utrecht, Holland

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Teachers' Center Project
Southern Illinois University
Edwardsville, Illinois 62026

TOWARDS A FEELING FOR NUMBERS

by

Bob Jeffery
Principal Lecturer in Education and Mathematics
West London Institute of Higher Education

INTRODUCTION

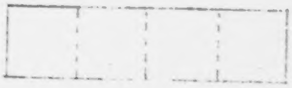
This is just part of a story - I say part because the beginning is lost in half-remembered detail of my own first steps in teaching and the end is not yet in sight. I can only tell that part of the story that is most sharply in focus - the part that spans the years 1975 - 1980. The story is mainly about teaching arithmetic and is illustrated with classroom activities and children's thoughts. If you find the illustrations more interesting than the story, that's fine - we all have our own stories to tell!

A PROCESS-ENRICHED CURRICULUM?

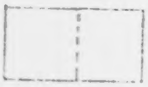
In 1975 I began some work on children's explanations in mathematics. I sought to gain some insight into the process by which children might become convinced that a conjecture was true. The context of the work was that of 10 year old children exploring mathematical situations, making conjectures and supporting or defending these conjectures with explanations. My own efforts were part of a wider attempt to look at the feasibility of developing a process-enriched curriculum, that is a curriculum which would reflect the strategies and general styles of thinking that lead to the establishment of mathematical results. Those interested in the finer detail could read Bell (1976) and Jeffery (1978).

You can capture the flavour of some of the mathematical situations by trying the following problems. Remember that you might be called upon to justify your conclusions!

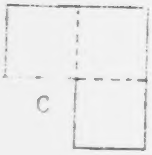
> A man has to post a parcel costing 23p. He has plenty of 5p and 7p stamps but no others. Can he put on the correct amount using either kind of stamp or a mixture of the two?



A

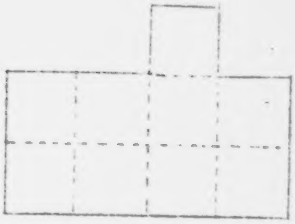


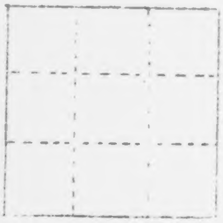
B

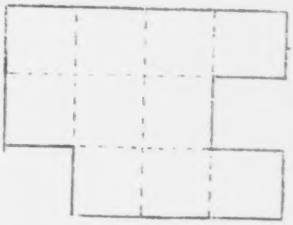


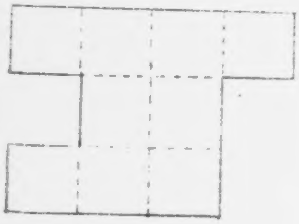
C

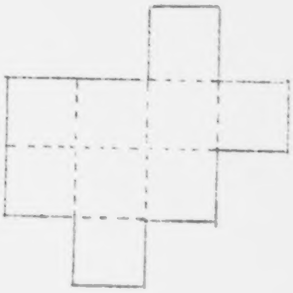
Which of the the following shapes can you make using just the pieces A, B and C each time?

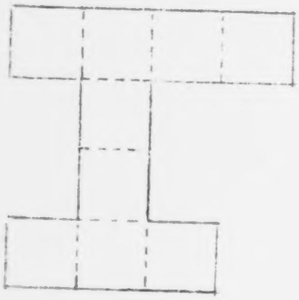








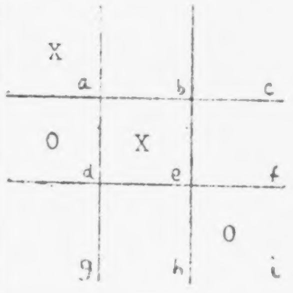




What kind of explanations could you offer to convince me that the stamps problem and some of the shapes problems are impossible? Of course while most children can reach the correct conclusion, justifying the conclusion is quite another matter! Some of the impossible constructions appear to be easier to explain than others.

Let us look at just one example - one of the more difficult ones. A convincing explanation of why it is impossible to make the last shape might involve a reduction of alternatives, probably based on the two positions for shape A. It would be tempting to justify the fact that (in my experience) the majority of 10 year olds cannot produce a written explanation of this type by pointing to the logical complexity of the reasoning required (see for example Lunzer (1973)). But an assumption of this kind presents us with an apparent paradox which I can best illustrate by giving an example from the game 'Noughts and Crosses'.

Nishi (age 10) was one of a number of children asked to comment on the advisability of certain projected moves in games of Noughts and Crosses. The projected moves were presented in the form shown below.



Mark is going to put a cross in space (b). Is this a good move?

Nishi Mark is right, because he has two squares to make a line and if his player goes in one of those squares Mark can put it in the other one.

Nishi obtained a lower than average score on a standardised test of verbal reasoning, failed to explain the more difficult shapes constructions but quite clearly demonstrates here the ability to engage in quite complex reasoning involving the reduction of alternatives. Testers beware!

Of course the complexity of reasoning required is not nearly as great as that required to solve problems such as 1337 ÷ 17 = ... But I will return to the teaching of arithmetic later.

I am not going to offer any simple explanations for the apparently conflicting evidence on children's reasoning. However, I will make two observations which I think are relevant and these in turn will help me develop the story a little further.

1. One difference between the 'Shapes' and 'Noughts and Crosses' exercises is familiarity of context. In this case we might assume that familiarity of context comes from some kind of deep engagement in the game over a longish period of time. Perhaps we should work harder to promote (permit?) more deep engagement in the mathematics classroom?

2. Explanation is essentially an act of communication (as to some extent is mathematical proof). The explainer must therefore be aware of the need to make contact with another person's knowledge and also be prepared to work at convincing the other person. The most hopeful way of promoting this dynamic strategy would seem to be to practise it!

With these two points in mind I turned my attention to the question of mathematical activity.

MATHEMATICAL ACTIVITY

In my investigation of children's explanations in mathematics I was now interested to discover if it was possible to do anything to promote 'better explanations'. I drew up a blueprint for the type of mathematical situation I needed. Briefly this would offer opportunities to engage in some or all of the following.

1. Experimenting in open mathematical situations.
2. Generating examples to satisfy given conditions or to test a given conjecture.
3. Classifying and ordering results systematically.
4. Recognising and extending a pattern or relationship.
5. Expressing a relationship in general terms.

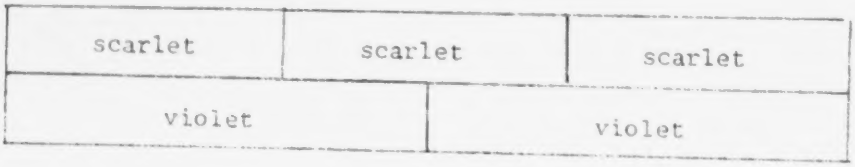
6. Making conjectures.
7. Recognising the class of cases for which a generalisation is true.
8. Making a careful statement of a conclusion.
9. Connecting data, generated examples and conclusion logically.
10. Challenging and defending conclusions.

It might be thought that satisfying such criteria would be a tall order but there is no lack of starting points for mathematical activity of this kind. Perhaps one of the richest sources is in the publications of the Association of Teachers of Mathematics including the journal 'Mathematics Teaching', informal pamphlets and the two books on Primary Mathematics (1967 and 1977).

But while starting points are easy to come by, there can be no easy formula for how the teacher operates in the classroom and, of course, on-the-spot decisions must be taken about when and how to promote the challenging and defending of conclusions. I will offer one example to show something of my struggle during this period. The starting point 'Equal Trains' comes from ATM (1972) and the account is an extract from Jeffery (1977a).

EQUAL TRAINS

Colour Factor rods (similar to Cuisenaire) were used to make single colour 'trains' and the starting point was to make the shortest trains of equal length for a given pair of colours. For example, with scarlet (4 cm) and violet (6 cm) the shortest equal trains have length 12 cm.



It was surprising how quickly the first conjecture arose. On several tables I heard 'you just times the lengths'. Some stated this on the basis of one result. Others who had started with scarlet (4 cm) and violet (6 cm) where no such pattern emerged were rather perplexed and thought that they had made a mistake. After a while there seemed to be general agreement that the product rule did not apply in all cases and enthusiasm seemed to be on the wane. We collected all of the results that had been generated and wrote them on the blackboard.

1st rod	2nd rod	length of train	
light blue (3)	pink (2)	6	3 x 2 = 6
white (1)	light blue (3)	3	1 x 3 = 3
scarlet (4)	light blue (3)	12	4 x 3 = 12
scarlet (4)	violet (6)	12	*******
yellow (5)	pink (2)	10	5 x 2 = 10
amber (10)	scarlet (4)	20	*******
grey (7)	yellow (5)	35	7 x 5 = 35
royal blue (9)	violet (6)	18	*******
pink (2)	grey (7)	14	2 x 7 = 14
dark grey (11)	crimson (8)	88	11 x 8 = 88
royal blue (9)	mauve (12)	36	*******
pink (2)	scarlet (4)	4	*******

I realised that we were now at a critical point in the lesson. If we could not find some worthwhile goal, this was the end of the investigation. Ian saved the day by suggesting that 'the rule' only worked when there was an even number and an odd number. This was disputed by others and we had a focus for further thought - "when does 'the rule' work"? I suggested that theories should be written down and although a minority preferred to generate more examples rather than formulate rules we ended up with quite a selection some of which are listed below.

> 'If you have an even number - say 12 and you pick the number that is half of it - 6, well it won't work. Always half the number never works.'

> 'If the lower number goes into the higher number it won't work.'
>
> 'When you miss one out between the numbers it doesn't work.' (I discovered that this meant that there was a difference of of 2 between the lengths!)
>
> 'It doesn't work if the lower number goes into the higher number.'
>
> 'The rule doesn't work if they are both even.'
>
> 'If half of one number goes into the other, the rule won't work.'
>
> 'It doesn't work if one of the rods is scarlet.' (4 cm)

I suspect that some of these conjectures were based on the set of results generated by a particular group rather than on the shared results that had been written on the blackboard. I saw no evidence of the generation of further examples to test a conjecture.

Here then was the ideal opportunity to consider the construction of general statements. We had already experienced the fact that it was necessary to identify a class of cases for which a general statement (the rule) was true. The attempts at identification had resulted in further general statements and carried some important warnings about the dangers of over-generalisation.

In the next lesson I presented three qualifications of the product rules (listed below), attributed to fictitious children although based on the ideas generated in the previous lesson.

Peter	When the lengths are even the rule doesn't work.
Jane	It doesn't work when one of the rods is scarlet. (4 cm)
Jim	It doesn't work when you can find a number that goes into both lengths.

I asked the children to write down what they thought about each statement and to choose the 'best' one. The rods and the table that had been written on the blackboard were available if needed. The selection of responses given below indicates the range of understanding.

Peter's Rule

Kim	Wrong, because it doesn't give very much description of what it does mean.
Rajnish	Wrong, it doesn't work for all of them.
Eric	Wrong, because it doesn't work on odd numbers as well.
Ian	This is wrong as in royal blue (9) and Mauve (12) the lengths are not even and still it does not work.

Jane's Rule

Rajnish	Wrong, it works if a rod is scarlet.
Alkamati	Wrong, it does work if one of the rods is scarlet - yellow and scarlet.
Ian	This is wrong as in royal blue (9) and violet (6) there isn't a scarlet and it still doesn't work.
Manisha	Jane is wrong, it doesn't matter about the colours.
Iftikhar	It does not work because scarlet and light blue does work and so Jane is wrong.

Jim's Rule

Kim	It does work because he has more detail of what he does mean.
Balvinder	Right, because all the numbers that are wrong are invisible (!) by the same number.
Surjiben	I think it is Jim because it can't be Jane and Peter that's why because it is sensible.
Sanjay	Right because the other two reasons don't work for all the numbers.

Maria This rule is best, it does work, because you can share 2 or 3 into each number that does not work with the other rule.

Manisha Jim is right because (e.g.) Amber 10, Scarlet 4 = 20.

Only 4/36 children failed to choose Jim's explanation as being the best (3 made no choice and 1 chose Peter). Many of the choices were the result of group discussion.

Viewed from the content standpoint it could be argued that not much was achieved in these two sessions - perhaps a better 'feeling' for factors and multiples is all that could be claimed. However, if we consider the activity as an experience of the process which leads to the establishment of mathematical results we find many of the strategies which are typical of this process - generating and tabulating results, constructing classes, making conjectures, identifying new questions, testing conjectures, engaging in discussions and arguments about individual conjectures and establishing 'agreed' results.

I have deliberately chosen to report on an activity which ends somewhat 'in the air' although I could have selected one which would appear to reach a more tidy conclusion. I say 'appear' because I suspect that most class or group activity leaves a proportion of the children not just 'in the air' but also in a rather dense fog. Perhaps to establish the principle that it is acceptable to be in a state of less than perfect knowledge (however clever you are) would be helpful in providing motivation for children of all abilities. In the examples quoted above I have tried to indicate the range of understanding from those who apparently feel that rules with more details must be best to those who are able to construct and present a simple proof by counterexample.

* * * * * * * * * * * * * *

And did they all produce better explanations as a result of all this? Well, a cautious 'yes' is the only short answer but the teaching experiment had much greater significance for me than this. I had found new teaching strategies that I could employ which seemed to increase the amount of thinking about mathematics in a given time! It was at about this time that W W Sawyer came to lecture at the West London Institute on 'Some Experiences and Strategies for Improving Mathematical Education'. Some time later I wrote in an editorial to the West London Mathematics Centre Journal:

> If children don't think they won't learn! I owe this amazing discovery to W W Sawyer who compares the efficiency of a mathematics lesson with the efficiency of a steam engine. The efficiency of a mathematics lesson is measured by working out the percentage of available time spent in thinking about mathematics for each pupil and then taking the average for all pupils. I find that to pause in the middle of a lesson and to make a guess at what this figure would be if calculated, is a very sobering experience.

SO-CALLED SELF-EVIDENT TRUTHS

1977 was the year when the debate about 'standards' and 'basic numeracy' reached a peak in the United Kingdom. Suddenly it seemed that politicians, captains of industry and even the man in the street knew an awful lot about how to teach mathematics. A number of 'self-evident truths' about mathematics teaching were promoted and attracted a fair measure of support in the mass media. A day in the classroom was all that was needed to undermine these 'truths' but that is not the way of such things. In a fit of depression I attempted to catalogue these truths in an article in the Times Educational Supplement (18.3.77).

> There was once a Golden Age of Teaching, when no-nonsense methods produced acceptable standards of numeracy with the majority of children.
>
> Now because of the rise of progressive teaching methods and also a shift in emphasis in the curriculum, many children no longer acquire the necessary basic skills - in short standards have fallen.

> The solution is simple and involves a return to previous well-tried methods, coupled with a close monitoring of both teaching methods and curriculum to make teachers toe the line.

A note for the casual reader - I DO NOT BELIEVE THIS!

At about the same time Alistair McIntosh (1977) exploded the myth by quoting from reports about standards in these earlier 'Golden Ages'. The report of Stafford and Derby Inspectors (1876) included the following:

> If children fail in other subjects they fail more often here (in arithmetic). It is a subject which seems beyond the comprehension of the rural mind.
>
> In arithmetic, I regret to say worse results than ever before have been obtained - this is partly attributable, no doubt to my having so framed my sums as to require rather more intelligence than before: the failures are almost invariably traceable to radically imperfect teaching.

The message seems quite clear - IT'S ALWAYS BEEN DIFFICULT!

It is fairly obvious to see why 1977 marked the diversion of some of my energies into thinking about arithmetic! But remember, I did mention the problem 1337 ÷ 17 = ... earlier. These matters are not unconnected.

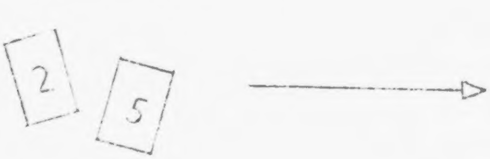
CURRICULUM DEVELOPMENT PROJECT

In September 1977, together with a colleague Mary Jakeman (formerly Mary Harris) I embarked on a new venture called the 'Primary Mathematics Curriculum Development Project 7 - 11'. The next part of the story is told through an extract from a report on the early stages of this project (Harris and Jeffery, 1977).

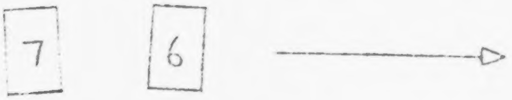
Scene: a second year classroom in a junior school not a thousand miles from WLIHE.

Cast: 38 children
1 class teacher
1 head teacher
1 tutor from WLIHE

The children have been engaged in mathematical activity for about thirty minutes. One group of four children have been working with a set of cards with each card representing one of the digits 0 - 9. They are currently playing a game in which the cards are placed face downwards on the table and then each player selects two cards. They then proceed as follows:



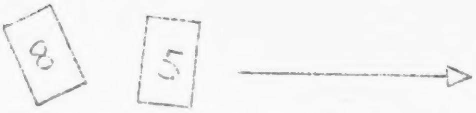
$$\begin{array}{r} 25 \\ +\,52 \\ \hline 77 \\ \hline \end{array}$$



$$\begin{array}{r} 76 \\ +\,67 \\ \hline 143 \\ \hline \end{array}$$

In each round the player with the greatest total scores a point.

The three adults have at last found time to meet and exchange a few words on 'how things are going'. It is generally agreed that the noise is a 'busy noise'. There are many issues to discuss. Does this activity have any advantage over using a textbook for addition practice? Wouldn't it be easier to keep a check on progress if the children were working from a textbook? 'Hard sums' often precede 'easy sums' in this game - is this a problem? Has anyone noticed that the results are always in the 11 times table? The discussion is cut short when we note what the 'winner' is doing.



$$\begin{array}{r} 8\ 5 \\ +\ 5\ 8 \\ \hline 1\ 3\ 1\ 3 \\ \hline \end{array} \quad !$$

For a moment all of the misgivings seem to be justified and then a girl leans across the table and points at the offending sum.

> "Here, you can't do that - that's a ten and you have to carry it over into the tens!"

This is just one of the many classroom incidents which have caused us to pause and reflect during the first term of the Primary Mathematics Curriculum Development Project (7 - 11). Teachers from nine schools in Hounslow and Richmond and two members of staff at WLIHE (the authors of this report) are taking part in the Project The general pattern of membership is two teachers from each school although in some cases more staff attend the meetings on Mondays after school and head teachers can (and do!) attend as well. This report is an attempt to indicate the purpose of the Project and to convey some of the problems facing those engaged in work of this kind.

The reader could be excused for asking why a curriculum development project is needed at all. After all, there is no lack of published guides, textbooks or systems of workcards (some more coherent than others). However, perhaps the most important lesson we have learned in recent years is that sensible change requires both understanding and consent on the part of those who are involved in the process, and this required more than circulation of the printed word. It is one thing for individuals or groups to write down what they wish to do, but quite another to change what happens in another classroom, another school or in all the schools of a nation.

The task that we have set ourselves is to develop an approach to the teaching of number (in its broadest sense) for those involved in the Project. We have no plans (at the moment) to change the world!

(The report goes on to outline some of the materials and activities that were developed in the early stages of the Project.)

* * * * * * * * * * * * * *

During the next two years I found myself using certain terms such as 'a feeling for number', 'local rigour' and 'strategies' with some frequency, aware that they could well have acquired a special meaning for those associated with the Project - a meaning not shared by others. I intend to use some of these terms as headings as I continue the story and I hope that the reader will be able to get a feeling for our shared meaning.

A FEELING FOR NUMBER

We soon grew to dislike using the word 'understand' - even psychologists recognise its limitations - see Skemp (1976) for example. So often when 'understand' is used in the mathematics classroom it is used in a misleading way. Consider the following examples.

Statement	Meaning
Do you understand?	Do you know what I want you to do?
I don't understand.	I am not willing to try this by myself.
I understand.	Go away - I won't let you expose my weaknesses again.

Do you recognise any of these? Can you think of other examples? We used the term 'a feeling for number' in the context of arithmetic where others might use 'understand'. It conveys both the sense of being able to relate new experiences to old ones and to be able to move about in the world of numbers with confidence and fluency.

We sought classroom activities that would not only promote a better feeling for number but also provide the teacher with some feedback. The following simple example is about a feeling for order.

TENS PATIENCE

An individual or group activity

Materials: 1 - 100 number cards
1 x 10 squared board as shown (a ladder)

Take 10 cards but don't look at them. Now turn them up one-by-one and place them on the ladder. The aim is to get them all on the ladder in the correct order - but once you have placed a card you cannot move it.

Here is a record of a game.

1st card (23)		23								
2nd card (42)		23		42						
3rd card (58)		23		42	58					
4th card (49)		23		42	58					
5th card (72)		23		42	58			72		
6th card (93)		23		42	58			72		93
7th card (2)	2	23		42	58			72		93
8th card (5)	2	23		42	58			72		93
9th card (61)	2	23		42	58	61		72		93
10th card (77)	2	23		42	58	61		72	77	93

49 and 5 cannot be played as no space has been left in the order. The score is 8 out of 10. 7 out of 10 is about average for the game. 10 out of 10 is quite rare!

Reading the rules for a game can be quite daunting. The best way to learn is to play with someone who knows how to play. However, once you know the rules it is nice to discover that you can make a minor adjustment and make it harder (or easier). Possible variations include using cards numbered 101 - 200 or 0.1 - 10.0 if you want to make it really tough.

The next activity is about factors and prime numbers.

GRAB

A group activity - about 4 children.

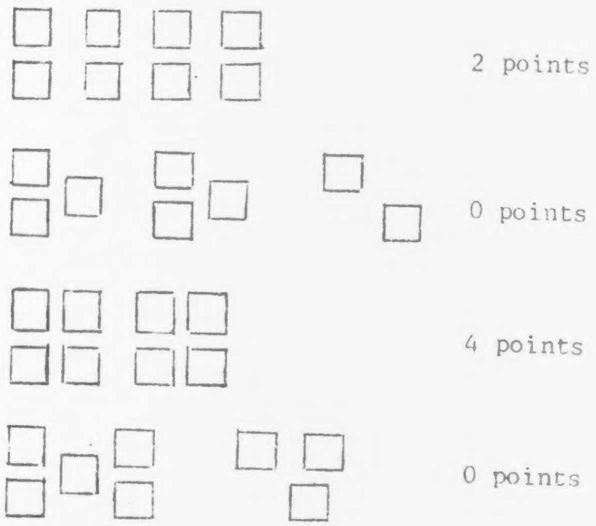
Materials: A pile of cubes or pebbles

Players each grab a handful of cubes. The scoring system is as follows:

2 points if you can make sets of 2 with no remainder
3 points if you can make sets of 3 with no remainder
4 points if you can make sets of 4 with no remainder
5 points if you can make sets of 5 with no remainder

That is the end of the game - each player totals his points.

With 8 cubes the game would look like this



Total: 6 points

Variation is built in to the game - bigger hands get more cubes! You can of course use smaller cubes to achieve the same effect. When the game has been played on several occasions the time has come to ask some searching questions - which number would you most like to grab? A group of 7 year olds worked at this in odd moments during a period of 1 week. Here is a selection of their pieces of writing about Grab.

Kingy I will tell you how to play Grab. First you get a load of some bricks. Two people can play. Get one hand full of the load and put them into sets of two, three, four or five.

Ewan When I played Grab I found that I picked up 30 and it was quite good because the score was 10. I picked up some more bricks and I got 30 again and I built it into 2, 3 and 5 and I put them together and I had 10 again.

Paul When I played Grab my highest score was 11. 40 gave me 11 points. The highest score in the whole class was 14, the number that gave Joanne Fletcher full marks.

Joanne The number I would most like to grab is 60. I would like 60 because you can put 60 objects into groups of 2, 3, 4 and 5. That equals 14 which is top marks. The rottenest one I got was 17. That was one which didn't have any marks. I got the best number which was 60. I wished that I had grabbed 20 or 40 then I would have got the second best number.

Samantha The number I would most like to get in Grab is 60 or 120 because you get full marks, but with 20 or 40 you nearly get full marks. The lowest mark I got was 0 with number 11. The highest mark I got when I played with Abigail was 7. I think that Grab is a very good game indeed don't you?

LOCAL RIGOUR

This term stems from some writing by Freudenthal (1973). He observes that teacher and pupil operate on the basis of implicit rules which they obey rigorously until the time comes to move on to a new set of rules. For example, if you challenge a six year old to defend his answer to 3 + 5 (back to explanations again!) he will probably demonstrate on his fingers or some bricks. Of course he could use a similar method to obtain and justify the answer to much larger sums. However older children have (we hope) moved to a new level of rigour. Here it is agreed that simple results like 3 + 5 are memorised but larger sums such as 13 + 15 are computed by a completely new process. This is done by dealing with the tens (10 + 10) and units (3 + 5) separately and then combining the results. We will discuss some of these informal rules later but first of all let us consider how we can find out what set of informal rules a child is obeying.

We tried a number of exercises to find out about individual children's informal rules. The one I am going to describe is called the 'doubling exercise'. We asked children to work out a series of doubles in their heads, 8 + 8, 13 + 13, 16 + 16, 37 + 37, 120 + 120, 128 + 128, 160 + 160, 164 + 164, and so on. Of course we stopped if the child could not answer but for each answer we obtained we asked "How do you know?".

It was quite clear that when you have moved on beyond demonstrations with fingers it is impossible to respond to the challenge "How do you know 8 and 8 makes 16?". "I just know." was a frequent response, although we did have quite a few who said "God told me.". Most of our group felt happy when they obtained "30 and 30 makes 60, 7 and 7 makes 14, 60 and 14 makes 74." but less happy with "7 and 7 makes 1 put a 4 and carry the 1, 3 and 3 and 1 makes 7, answer 74." - what do you think? It does seem that those who are most at ease with numbers leave the units (ones) until last when they work out sums in their heads.

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STRUCTURES AND STRATEGIES

It was once thought a good idea to try and make some of the structural aspects of arithmetic (the laws of arithmetic) explicit in the mathematics classroom . Hence the endless exercises of this type to hammer home the distributive law:

$$\begin{aligned} 3 \times (2 + 7) &= (3 \times 2) + (3 \times 7) \\ &= 6 + 21 \\ &= 27 \end{aligned}$$

I prefer Freudenthal's notion of the rules developing without necessarily being made explicit and certainly not organised in neat and tidy systems by mathematicians! Of course we can think of the distributive law when we multiply in a place value system but we can also take a simpler view. We can proceed on the notion of 'what is fair' - is it fair to split up a number into tens and ones and deal with them separately? Probably Cuisenaire Rods offer the best opportunities for children to come to an understanding of what is fair but that is a story that is too long to tell here.

As well as a notion of what is fair children need some strategies. A strategy is nothing more than a good idea to try when you are stuck! It is a good idea to work out your 17 times table if you have a problem like 738 ÷ 17. It is a good idea to think of 53 as 40 + 13 if you are trying to subtract 17. Sometimes there is a better idea!

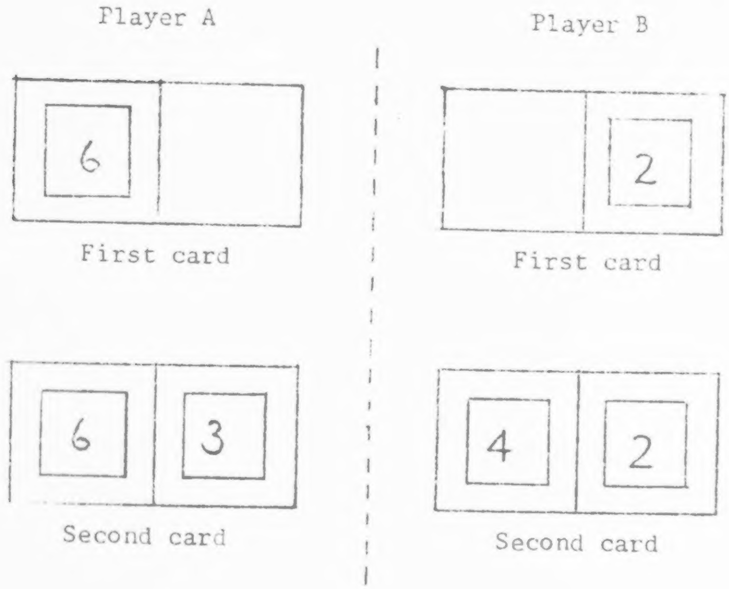
The activities that follow have these points very much in mind and are also closely associated with place value.

HIGHS AND LOWS

A group activity for 2, 3 or 4 children.

Materials: A counting board for each child (TU or HTU)
0 - 9 number cards, 2 of each

We will consider a simple version with tens and units only. The cards are place face-down on the table and the players take one each. Each player can place his card in the tens or the units (ones) position on his own counting board. Each player takes a second card and places it in the remaining space on his counting board. The player with the highest number wins. A typical game is described below.



Player A wins

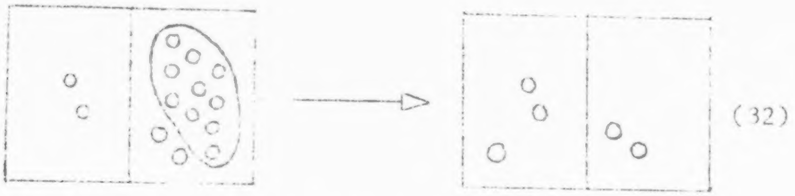
Highs - highest number, Lows - lowest number. Also, nearest to 47 wins. Hundreds, tens and units version has similar rules but each player takes 3 cards.

BUILDING UP AND KNOCKING DOWN

A group activity for 2, 3 or 4 children

Materials: A counting board for each child (TU or HTU)
Counters, bottle tops or something similar
A 1 - 6 die

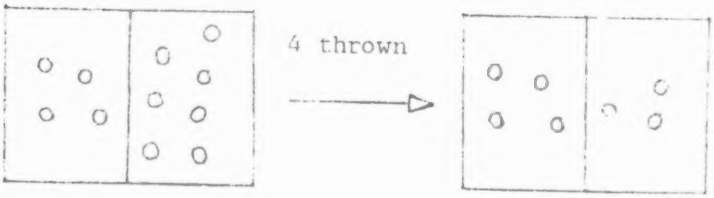
In Building Up each child throws the die and takes the number of counters shown and places them in the units (ones) space. This is repeated but as soon as there are enough units to make one ten the exchange must be made. For example:



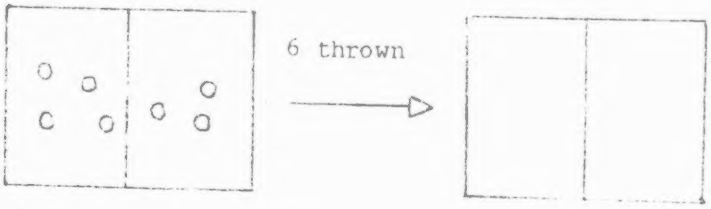
The first to some specified number (say 45) is the winner.

In Knocking Down each child starts with the same number represented on the counting board. They take turns to throw the die as before but this time the number shown must be taken from the units space.

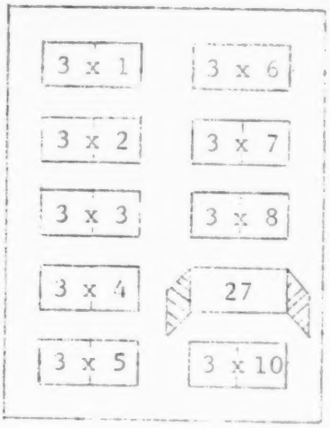
So this is easy.....

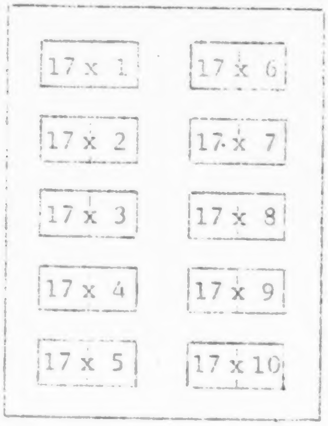


But what about this?



WINDOWS


3 x 1
3 x 6
3 x 2
3 x 7
3 x 3
3 x 8
3 x 4
27
3 x 5
3 x 10


17 x 1
17 x 6
17 x 2
17 x 7
17 x 3
17 x 8
17 x 4
17 x 9
17 x 5
17 x 10

This is a discussion activity.

Materials: 'Windows' as shown above
(Also known as Advent Calendars!)

There is just one rule for the discussion - windows must be referred to by the label on the shutters (e.g. 3 x 8) rather than the label inside (24 in this case).

Try these questions.

Which window(s) would you look in to find out

... how many legs on 7 3-legged stools?

... the answer to 3 x 14?

... the answer to 17 x 13?

... how many 3-button coats you could make with 15 buttons?

... how many 3-button coats you could make with 25 buttons?

... how many 3-button coats you could make with 51 buttons?

continued...

WINDOWS (continued)

... how many 3-button coats you could make with 44 buttons?

... the answer to 24 ÷ 3?

... how many 3's in 48?

... how many 17's in 102?

... the answer to 221 ÷ 17?

It is quite alright to guess at some of the more difficult ones as long as you make a better guess if you need a second attempt! Guessing is an important strategy in division.

I regard the windows as a small personal breakthrough. At last I have found some activities which are good fun and at the same time offer children the opportunity to develop their own strategies for multiplication and division. Notice that the windows activities concentrate on using facts some of which might be usefully be memorised.

FACTS

Of course it is important to be able to remember some facts about numbers. Don't forget however, that some have quick recall rather than instant recall of these facts - for example, when asked to give the answer to 7 + 8 they might double 7 and add 1.

If working at facts is something that must be done we ought to make sure that children get maximum value out of the experience. The following activities are all about addition/subtraction facts or multiplication/division facts but they do involve thinking and reasoning as well.

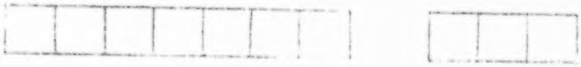
BREAKING STICKS

An individual or group activity.

Materials: Interlocking cubes

Make a stick of 10 cubes

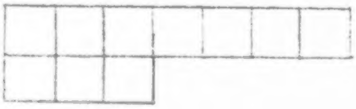
Break it into 2 parts



How many ways are there of breaking this stick into 2 parts? How would you record your findings? Try with other lengths of stick. Try breaking into 3 parts.

Extension

Take a 10 stick and break it into 2 parts again but this time compare the parts like this.



What is the difference? What other differences can you make by breaking a 10 stick? What differences can you make by breaking other lengths of stick?

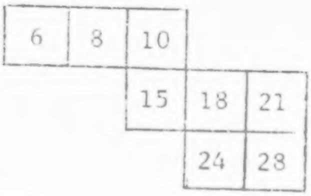
Can you find any pattern in the results?

TABLE SQUARES

1	2	3	4	5	6	7	8	9	10
2	4	6	8	10	12	14	16	18	20
3	6	9	12	15	18	21	24	27	30
4	8	12	16	20	24	28	32	36	40
5	10	15	20	25	30	35	40	45	50
6	12	18	24	30	36	42	48	54	60
7	14	21	28	35	42	49	56	63	70
8	16	24	32	40	48	56	64	72	80
9	18	27	36	45	54	63	72	81	90
10	20	30	40	50	60	70	80	90	100

These activities are all based on the table square.

Table jig-saws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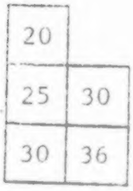
28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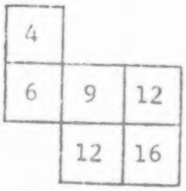


I hope that this one is obvious!

continued....

TABLE SQUARES (continued)

Missing numbers

These are pieces of the jig-saw but some of the numbers have disappeared. Can you find the missing numbers?

4	5
8	

	10
12	

	12
	15

	90
90	

35	
	48

		8
12		16

		18
21		

		24
24		

	49	

				30
16				

Try other shapes.

DICE GAMES

Throw two dice and record the sum of the two numbers. You may find it helpful to make a tally like this.

2	
3	III
4	I
5	𝍸
6	III
7	𝍸 II
8	IIII
9	III
10	III
11	
12	I

Tally

+	1	2	3	4	5	6
1	2	3	4	5	6	7
2	3	4	5	6	7	8
3	4	5	6	7	8	9
4	5	6	7	8	9	10
5	6	7	8	9	10	11
6	7	8	9	10	11	12

Addition table

Keep going for about 100 throws and see if you can find a pattern in the results. The addition table may help you find a reason for the pattern.

Variations

Try

...the product of the two numbers

...the difference between the two numbers

...using dice with some numbers repeated

...using dice with larger numbers

Can you predict the pattern each time?

Try inventing new operations like

... "add the numbers, divide by 10 and record the remainder"

... "add if one is odd and the other even, otherwise record the difference"

(continued)

DICE GAMES (continued)

Reverse Bingo (addition)

A game for 2 or more players

Materials: 1 card for each player
counters and 2 dice for each group

2	○ 3 ○	4 ○	5 ○ ○	6	✕
○ ○ 7 ○	8	9 ○	10	○ 11	12

Each player has 10 counters which must be placed on the numbered squares. The players take turns to throw the two dice. The numbers on the two dice are added and if there is a counter on the square that has the same number as the total, this counter can be removed. The first player to remove all of his counters is the winner.

What is the best way to arrange the counters on the board?

Reverse Bingo (multiplcation)

A similar game - the card is shown below.

1	2	3	4	5	6
8	9	10	12	15	16
18	20	24	25	30	36

MODELS

I remember hearing W W Sawyer observe that there was no argument in arithmetic that could not be settled with the aid of a box of bricks!

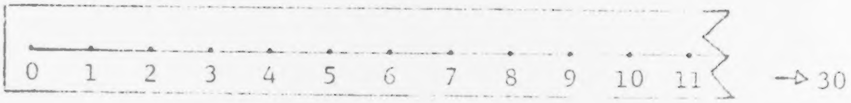
The term 'model' was used on the Project in what I must confess was rather a loose way. It covered rods, bricks, 0 - 30 number strips, counting boards and so on. Materials like this are not magic devices that can be applied to children to make them fluent with numbers. If a model is to be any use at all the child must become aware of the power of the model to help him solve his problems.

But how does a child become aware of the power of a model and how can you tell that he is aware? I think that the answer to the first part of the question is to find engaging activities with the model. The second part is not easy for quite often a mental picture of the model is all that is needed. Do you have a picture of a number line in your head? Is it the same picture as the one that I have? When I hear a child muttering about 'enough to make one bottle top in the tens place' and there is not a bottle top in sight I get just a brief glimpse of what might be taking place.

My current view is that we should regard these models as an 'offering' and be happy that some children find them useful.

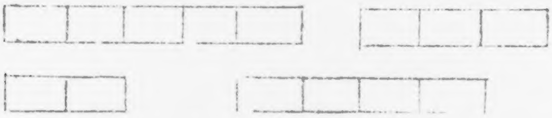
The activities that follow are about the number line. They constitute an offering, made in the belief that some children may find the number line to be a useful mental image. I do know that I am on rather dangerous ground drawing pictures of number lines and suggesting that a metre rule would do but I think that I could justify it if pressed!

NUMBER LINES



Paper number line (a metre rule might do!)

0 - 30 is probably the most useful but check the requirements for each activity.



Number strips - on the same scale as the number line (Cuisenaire rods might do!)

Can you make it?

3 or 4 children

0 - 30 number line and 2 sets of 1 - 10 strips

5 - 25 random number generator (number cards in a bag?)

Each child chooses 3 strips. A random number is generated and the children take it in turns to see if they can make the number by placing their strips end-to-end along the number line. If the number cannot be made one strip can be exchanged for another to be used in the next round of trials. The first player to make the number is the winner.

Tug of war

2 children

0 - 30 number line

1 - 6 die and one counter

The counter is placed on 17 (say). The players take turns to throw the die. One player moves the counter up the

NUMBER LINES (continued)

number line and the other moves it down (by the amount shown on the die). The first player to move the counter so that it is more than 6 units away from the starting point is the winner.

You can play this with a -30 to +30 number line.

Think of a number

Group or class activity
0 - 30 number lines and counters

Someone has to think of a number and then answer questions (yes or no) about it. The children keep track of things by placing counters on their number lines.

How many questions are needed?

It can be played with 0 - 100 and - 30 to + 30 number lines.

Up and down

Individual activity
0 - 30 or 0 - 100 number line and 2 - 10 number strips

Choose a strip and starting from 0 go up the number line by as many steps as you wish. Note the landing point and then choose another strip of a different length and go back in steps towards 0. The object is to choose a strip that will land you back on 0. Find as many solutions as you can.

e.g. 4 steps up the number line with a 6-strip lands on 24. The possible solutions are: 4-strip (6 steps), 2-strip (12 steps), 3-strip (8 steps), 8-strip (3 steps).

Take care not to land on 49! What are the other bad landing points?

(continued)

NUMBER LINES (continued)

Slide rules

Can you use two number lines to make a slide rule for addition and subtraction?

Footprints in the snow

Individual activity
0 - 30 or 0 - 100 number line, number strips and counters

Choose two strips to represent the length of the paces of two people walking through the snow. Starting at 0 take steps up the number line for each person (mark the footprints with different coloured counters). Note the places where the footprints co-incide. Can you predict the numbers?

Side-by-side

Individual activity
2 number lines

Put the numbers side by side and add the numbers that come next to each other. What do you notice? Slide one number line along a bit. Any changes? Try differences instead of sums.

Side-by-side and back-to-front

Speaks for itself!

Folding

If you fold a number line at 17, which number fits on to 6? Can you work it out in your head? How?

If you fold 3 on to 27, where does the fold come? Can you work this out without folding the number line.

This is only a very brief account of some of the work. The activities have been written with a view to encouraging adults to try them. If you use them in your classroom you must first bend them to your needs.

There is no tidy conclusion to this story and of course there is no tidy solution to the problems of teaching mathematics. For while it is just possible (but misguided) to think of mathematics as a tidy, well-ordered subject, learning and teaching is bound up with a host of complex human factors. The ATM in its evidence to a Government Committee of Enquiry Into Mathematics Teaching observed that the experience of its members led to the view that the learning of mathematics could well be

> "a jagged, pleasant, awkward, satisfying, troubling, thought-provoking, frustrating, exciting activity."

And so perhaps a fitting way to end is to test your feeling for numbers (or your ability to play golf!).

Look at the next page now.

GOLF

You have 3 clubs (represented by numbers 2, 5 and 8) and 3 hitting strengths (represented by 1, 6 and 7). To make a stroke you choose a club and a hitting strength and form the product of the two numbers. This will tell you how far the ball travels.

$\overrightarrow{5 \times 7}$ travels 35 units

If you go beyond the hole you have to hit back towards it.

$\overleftarrow{2 \times 6}$ 12 units back

Here is a record of how I got down in 4 on a hole of length 63.

63 $\overrightarrow{5 \times 7}$ $\overrightarrow{5 \times 7}$ $\overleftarrow{5 \times 1}$ $\overleftarrow{2 \times 1}$ (4 strokes)

Could you have done any better? Well try these then! (Par 26)

SCORE CARD

Name	Clubs 2,5,8	Strengths 1,6,7

Hole	Length		Strokes
1	26		
2	44		
3	90		
4	81		
5	73		
6	57		
7	48		
8	98		
9	159		
		Total	

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TWO PROBLEM SETS

by

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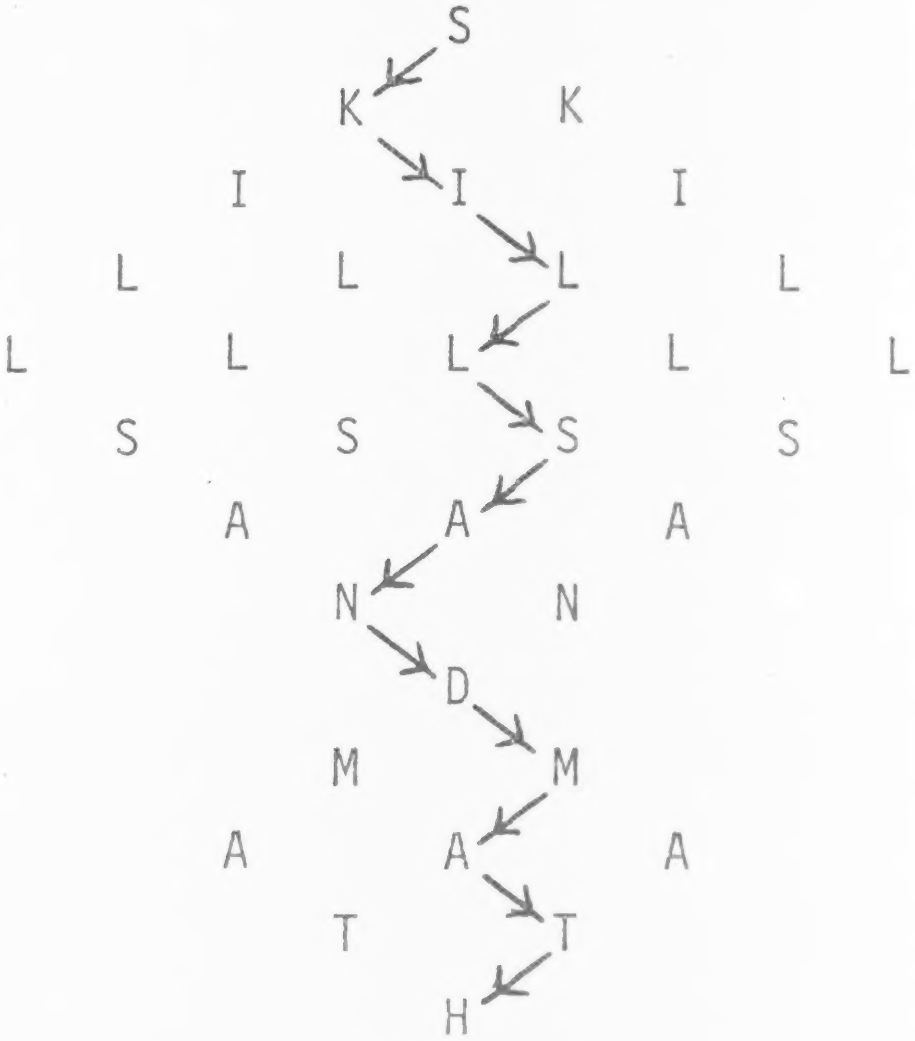
From skills to math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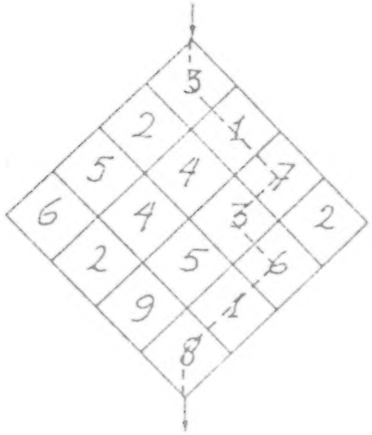
How many ways to read 'skills and math'

IOWO

HOLLAND

1 Numberwalk

1.1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5
4
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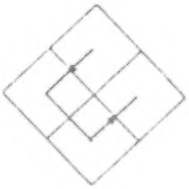
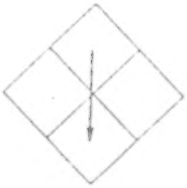
6
4
3
2
2
5
6
9
1
8

Rule: we only move downwards



wrong



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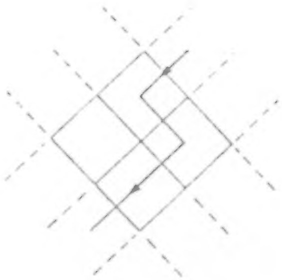
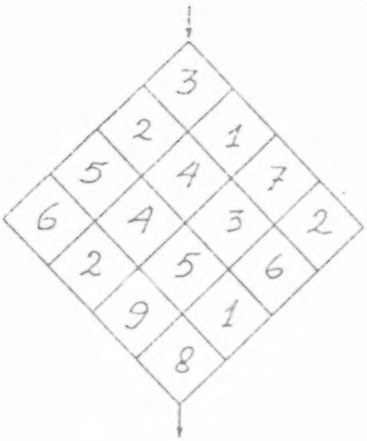


right

> What are the costs of this traveling-route?

1.2

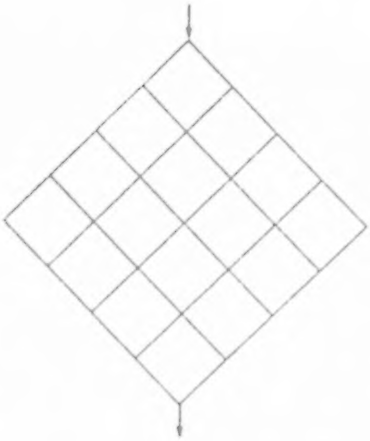


≫ Try to find a traveling route of 28.

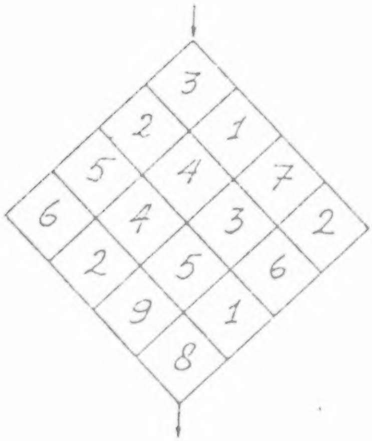
≫ Did you use the answer of 1.1 ?

≫ Are you sure you have got all routes of 28?

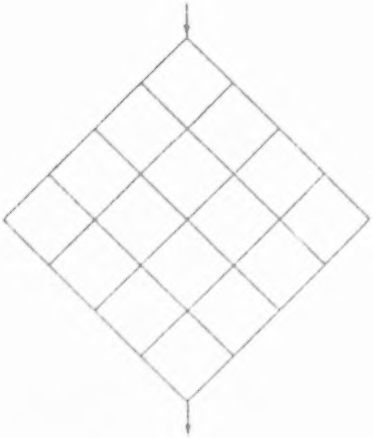
1.3 ≫ Try to find variantions on this problem.
Make up a problem yourself.



1.4 ≫ Which traveling-route is the most expensive one?


3
2
1
5
4
7
6
4
3
2
2
5
6
9
1
8

≫ Develop a strategy for finding the most expenxive route (a hard one).



2 Walking on a grid

In 1.4 we could have figured out all travelling-routes, although this was not necessary.

Nevertheless this is a nice problem.

Let us try it.

2.1 Take a look at page 5.
Every time you walk from *a* to *b* along the grid, one always chooses a shortest path.

Problem 1:

- ➢ What is the length of a shortest route?
- ➢ Count the number of shortest routes from *a* to *b*.
  You are not allowed to pass the barriered 'streets'.

Problem 2:

- ➢ Place barriers so that you can walk via a shortest route in 2, 1, 4, 5, 0 different ways, as indicated on the worksheet.
- ➢ Did you notice that in some cases there are more solutions?

- ➢ What is the didactical meaning of the problems 1 and 2?

Problem 3:

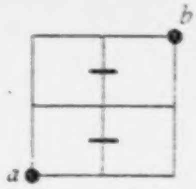
- ➢ Fill in the table.
  Explain the pattern.

Problem 4:

- ➢ What is the length of the shortest path from *a* to *b?*
- ➢ Try to find all different shortest travelling-routes from *a* to *b*.
  How did you do it?

2.2 ➢ Now try to solve the worksheet on page 6.

① ▶



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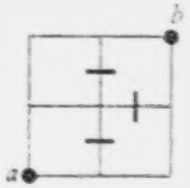

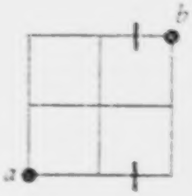

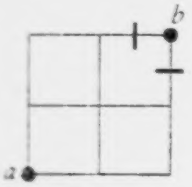

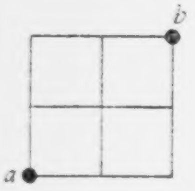

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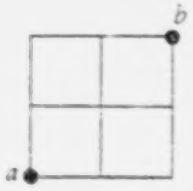
② ▶



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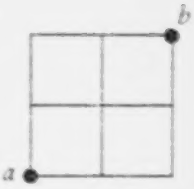

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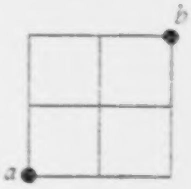

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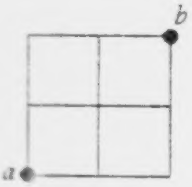

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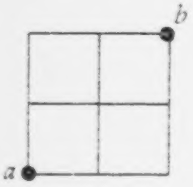

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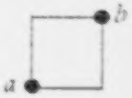
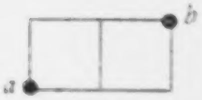
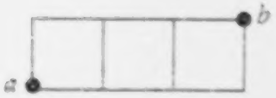
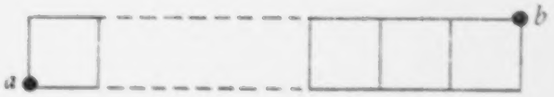
③ ▶



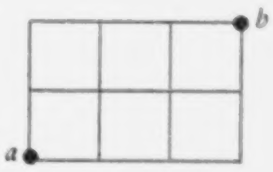






cells	routes
1	2
2	
3	
4	
5	
6	

④ ▶



OPGEBROKEN
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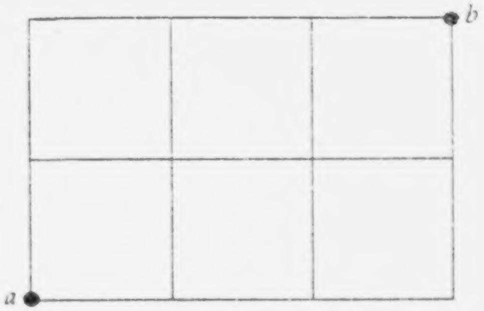
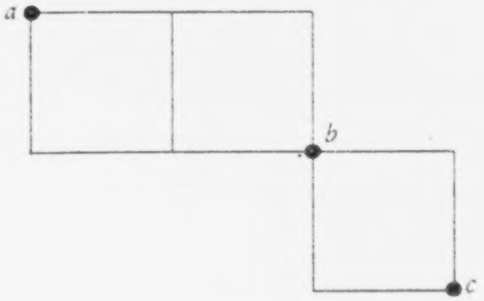
▶



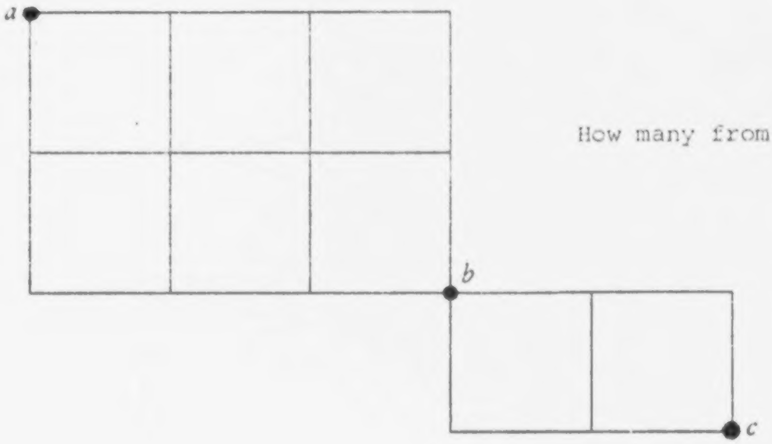
How many shortest routes from *a* to *b*?

▶



How many from *a* to *c* via *b*?

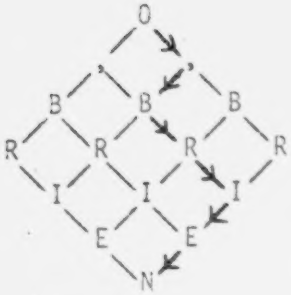
▶



How many from *a* to *c*?

▶ Make up a problem yourself.

2.3



⋗ Now you can find out all possible ways reading O'Brien.

⋗ Why is this number the same as the number of *all* different travelling routes in 1.4?

2.4 ⋗ *Didn't we find a lot of mathematics in these problems? Let's discuss it.*

USING TABLES IN MATH EDUCATION

2 x 4 =   4 x 5 =   8 x 5 =   6 x 3 =

8 x 3 =   8 x 2 =   7 x 8 =   5 x 9 =

3 x 9 =   6 x 5 =   6 x 2 =   7 x 6 =

4 x 7 =   4 x 3 =   2 x 9 =   9 x 6 =

x	2	5	3	7
4				
8				
6				
9				

x				
4	8			
			24	56
	12			42
		45	27	

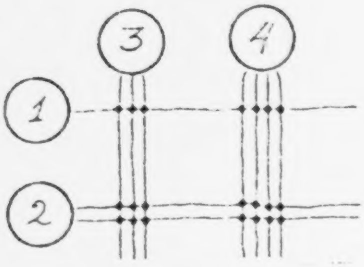
Four rows, a table and another table; all the same problems, or ...?

IOWO
HOLLAND

1 Didactical exploration.

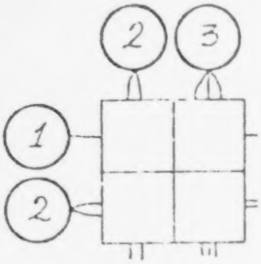
Young children, even adults sometimes have troubles in understanding tables.

1.1. Look at the strings and knots.



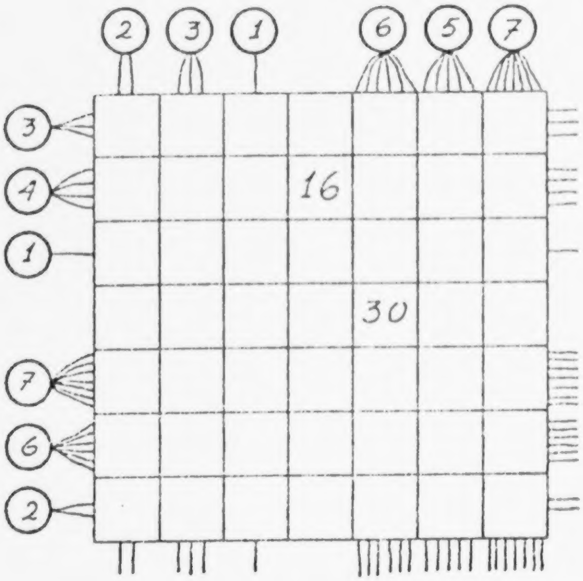
▶ How many knots do you count?

1.2. The knots are hidden.



▶ How many under every cell?

1.3.



2
3
1
6
5
7
3
4
1
7
6
2
16
30

- ► What sort of operations did you use?
- ► What meaning has this knotting?

1.4. ► Compare this one with 1.2.

?	2	3
1	2	3
2	4	6

What does the interragation-mark mean?

Which different functions do the nine cells have?

- ► We call this table a 'two by two' (2 x 2)-table. Why?
- ► Describe the different conceptions you may distinguish in a table. (Think of 'outside numbers' etc).
- ► How could you introduce tables in classroompractice.

2 Constructing tables.

2.1.

X	3	[illegible]	[illegible]	[illegible]
6	18	[illegible]	[illegible]	[illegible]
5	15	40	[illegible]	[illegible]
4	12	32	68	120
8	24	64	136	240

→

- ► A dirty spot on the table. Repair it.
- ► How many 'sums' in a 4 x 4-table.

2.2. Fill in the missing numbers.

▶ How can you do it systematically?

×	3		7	
2		8		12
	9			
4				
	15			

2.3. ▶ Fill in the missing numbers (only integers).

▶ How many solutions?

×	3		7	
		8		12
	9			
4				
	15			

×	3		7	
		8		12
	9			
4				
	15			

×	3		7	
		8		12
	9			
4				
	15			

×	3		7	
		8		12
	9			
4				
	15			

2.4.

X	3		7	
	15			
	9			
4				
2		8		12

▶ What is the difference between 2.4. and 2.2.?
Are the 'sums' the same?

2.5. ▶ Design a multiplication table yourself with missing outside numbers.
Try to leave out as many numbers as possible.

X				

X				

▶ What is the smallest amount of numbers you have to start with for finding one unique solution. (A hard one).
Can you also generalize this discovery?

2.6. ▶ Try to develop a 'recipe' to construct a table with missing numbers.

2.7. Classroompractice.

Now we found out how to construct difficult table problems ourselves.

- ▶ Which operations did we consider?
- ▶ What's the difference between table problems and traditional 'rows of sums'?
- ▶ What didactical problems does this imply?

3 Other operations.

3.1.

+	3		10	14		20
2					20	
				19		
8						
		16				29
						32
		25				

▶ Which operations are we using now?

3.2.

−	1	2	3	4	5	6
7						
8						
9						
10						
11						
12						

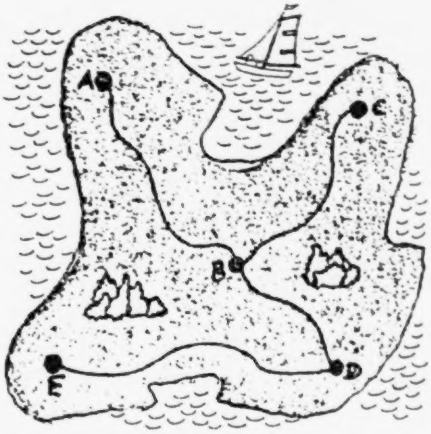
▶ Using a subtraction table, what didactical problem comes on now?

3.3.

−	5	3		6	
8					7
7		7-3			
10			6		
	1				
4					

- ▶ By defining a 'direction' the trouble may be over. Nevertheless,
- ▶ Someone, who constructed this tables disregarded something. Repair this 'fault'.
- ▶ How could you introduce in the classroom the necessity for the 'direction-arrow'.

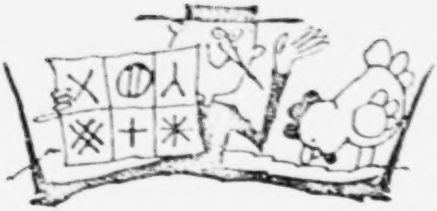
3.4.



	A	B	C	D	E
A		15		23	
B					
C			0		34
D					
E	39				

- ▶ Complete this table.
- ▶ What sort of operation is used?
- ▶ The table is symmetric. What does that mean?
- ▶ Maybe it is possible to use a 'table of distances' as a starting-point for introducing tables. Think it over. Compare with the didactical exploration in 1.

3.5. 28a *Zes tabellen*



Maak deze zes tabellen af
Wat je bij de vreemde tekens moet doen
vind je onderaan de bladzijde

×	14	18	6	10
18				
7		126		
9				
16				

⦶	14	18	6	10
18				
7		63		
9				
16				

⅄	14	18	6	10
18				
7		23		
9				
16				

⋇	14	18	6	10
18				
7		$12\frac{1}{2}$		
9				
16				

+	14	18	6	10
18				
7		25		
9				
16				

✱	14	18	6	10
18				
7		63		
9				
16				

× Dat weet je zelf wel!

⦶ Neem het eerste getal en vermenigvuldig dat met de helft van het tweede getal.

⅄ Neem het eerste getal tweemaal en doe er de helft van het tweede getal bij.

⋇ Neem de helft van het eerste getal en doe er de helft van het tweede getal bij.

+ Dat weet je zelf wel!

✱ Neem de helft van het eerste getal en vermenigvuldig die helft met het tweede getal.

Bij twee tabellen krijg je precies dezelfde getallen.

Hoe kan dat nu? ....

From a Dutch textbook.

'Translation'.

× : You know what it means.

Φ : Multiplicate the 'first' number with the hlaf of the 'second' number.

⅄ : Double the first number and add to the half of the second one.

⋇ : Take the half of the first number and add it ot the half of the second one.

+ : You know what it means.

✱ : Multiplicate the half of the first number with the second one.

- ► No problem with 'first' and 'second' number?
- ► Which tables are symmetric? Explain why.
- ► In the classroom may arise problems in reading the texts. Any idea to simplify?

3.6.

*	1	2	3	4
1	3	5	7	9
2	4	6	8	10
3	5	7	9	11
4	6	8	10	12

▶ What is the meaning of the operation *

▶ Make up such an 'odd' operation yourself.

3.7.

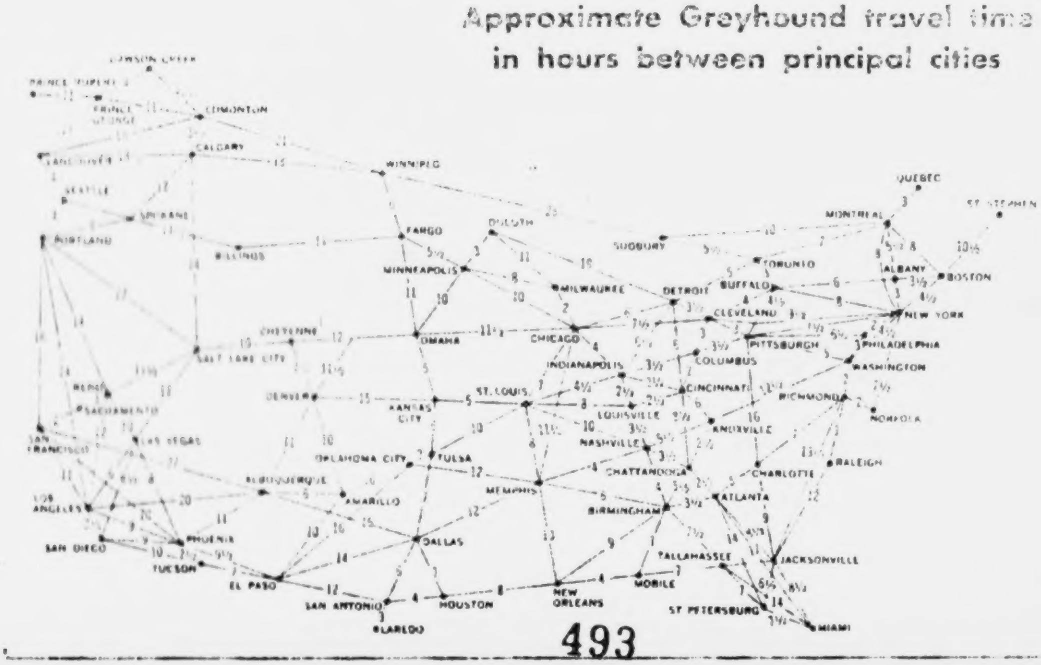
$\overset{\curvearrowright}{:}$	4	8	12	16
2				
4				
6				
8				

At last a division table.

▶ Look for some patterns and explain them.

4 More tables.

4.1.



Approximate Greyhound travel time in hours between principal cities

DAWSON CREEK
PRINCE RUPERT
PRINCE GEORGE
EDMONTON
CALGARY
VANCOUVER
WINNIPEG
SEATTLE
SPOKANE
PORTLAND
BILLINGS
FARGO
DULUTH
SUDBURY
QUEBEC
MONTREAL
ST. STEPHEN
TORONTO
ALBANY
BOSTON
MINNEAPOLIS
MILWAUKEE
DETROIT
BUFFALO
NEW YORK
CLEVELAND
PITTSBURGH
PHILADELPHIA
WASHINGTON
CHEYENNE
OMAHA
CHICAGO
COLUMBUS
SALT LAKE CITY
INDIANAPOLIS
CINCINNATI
RICHMOND
NORFOLK
RENO
SACRAMENTO
DENVER
KANSAS CITY
ST. LOUIS
LOUISVILLE
KNOXVILLE
SAN FRANCISCO
LAS VEGAS
NASHVILLE
RALEIGH
OKLAHOMA CITY
TULSA
CHATTANOOGA
CHARLOTTE
LOS ANGELES
ALBUQUERQUE
AMARILLO
MEMPHIS
ATLANTA
BIRMINGHAM
SAN DIEGO
PHOENIX
TUCSON
DALLAS
TALLAHASSEE
JACKSONVILLE
EL PASO
SAN ANTONIO
HOUSTON
NEW ORLEANS
MOBILE
ST PETERSBURG
MIAMI
LAREDO

TIME (hours)	Chicago	New York	San Francisco	St. Louis
Chicago				
New York				
San Francisco				
St. Louis	7			

FARE (dollars)	Chicago	New York	San Francisco	St. Louis
Chicago				
New York				
San Francisco				
St. Louis	23			

▶ Fill in both tables.

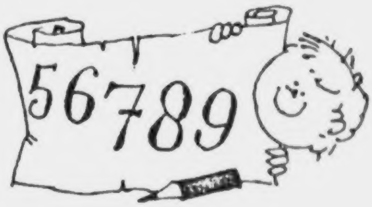
▶ What is going wrong?

▶ Could you use it in the classroom?

4.2. From a Dutch textbook.

X					7
6					
9				72	
5		45			
	42				

X	6				
			49		
				30	
		81			



- The outside numbers (as well horizontally as vertically) are 5, 6, 7, 8 and 9, but not in this array.
  Fill in the tables.
- Don't you think this is more than pure arithmetic?

4.3. From an American textbook.

Even without knowing any of the outside numbers, you can still fill in the ○. Try it. There are many possible outside numbers for each of these. Record them on the blank Puzzle Tables Master Sheets.

1)

+		
	10	12
	○	18

Number Patterns:
Across____________
Down____________

2)

+		
	8	11
	13	○

Number Patterns:
Across____________
Down____________

- Compare this one with the theorem you discovered in 2.5.
- How many different solutions are there? Are you sure?
- Do the number patterns also hold for bigger tables?

4.4. Een verrassing (1) A surprise

6	8	5	10	18	15
9	11	8	13	21	18
12	14	11	16	24	21
14	16	13	18	26	23
15	17	14	19	27	24
18	20	17	22	30	27

▶ Pick out any number (a) from this block, write it down.
Cross out the row and the columm to which (a) belongs.
Pick out any other number (b) which is not crossed out.
Write down this number (b).
Go on in this way four times more and write down these numbers: (c), (d), (e) and (f).
Add up all the number (a) through (f).
Compare your answers.

▶ Try to explain this result.

4.5. Calender.

april

zondag	1	8	15	22	29
maandag	2	9	16	23	30
dinsdag	3	10	17	24	
woensdag	4	11	18	25	
donderdag	5	12	19	26	
vrijdag	6	13	20	27	
zaterdag	7	14	21	28	

Choose any block of 4 x 4 numbers from a calender.

Pick out four numbers 'at random' in the same way as we did in 4.4.

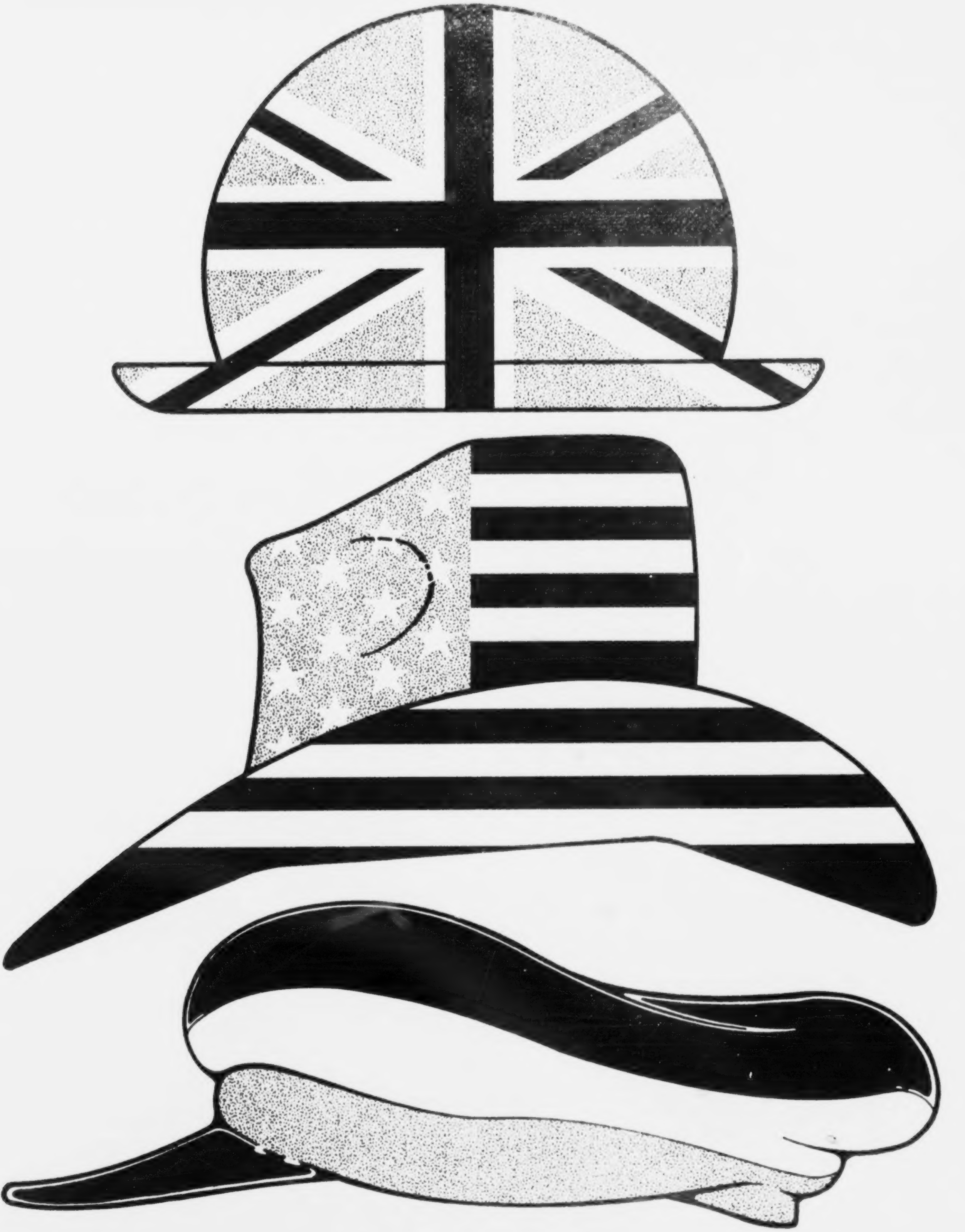
So mark a number cross out row and columm and so on. Four times.

▶ Show that the sum of the four numbers equals to the sum of the four corner numbers.

Example:

3	⑩	17	24
4	11	⑱	25
⑤	12	19	26
6	13	20	㉗

10 + 18 + 5 + 27 = 3 + 24 + 6 + 27.



SEEDBED

SEEDBED

Number 7

November, 1980

Teachers' Center Project
Southern Illinois University
at Edwardsville

INTRODUCTION TO SEEDBED

SEEDBED 7, the present issue, is a companion to SEEDBED 6. Both came from the 1980 Summer Course of the Teachers' Center Project.

As I said in the Introduction to SEEDBED 6, this work had its origins in 1972 at the Second International Congress in Mathematics Education, Exeter, Devon. (I won't re-state the events that followed, read SEEDBED 6; it's a joy.)

SEEDBED 7 is somewhat less formal than SEEDBED 6, which contained papers by Ed de Moor (IOWO, Holland), Bob Jeffery (ATM, U.K.) and myself. This SEEDBED is literally off the wall. It consists of comments, problems, solutions, ideas, and activities by participants in the summer course. Throughout the week scribbled pieces of paper went up on the wall for reading, solving, and bending. Here, with some papers sent in afterward (and more to come in future SEEDBEDS, as ideas grow and change through classroom use), are those pieces.

As with SEEDBED 6, this issue fails to convey fully the Summer Course. There are no super breakfast snacks, no body language, no British or Dutch accents (well, some; hurray!), no lunchtime or after-hours laughter. But, in the spirit of the course, there are lots of ideas. There is lots of sharing. There are lots of "bends".

Share with us, vicariously, the delight--and the spirit--of Summer 1980. (If you're interested, our tenth annual Summer Course is scheduled for the week of August 16, 1981.)

Special thanks to Bob and Ed for making the course so successful. Special thanks to the participants for their thoughtful and enthusiastic contributions. Special thanks to Shirley Casey, Theresa Ryan and Tonja Robins for editorial work on SEEDBED 7.

I have taken the liberty of including here a small number of other issues which crossed my path--Freudenthal and Sinclair in particular--which, though not part of our Summer Course, were in the mainstream of the Teachers' Center Project's work.

Thomas C. O'Brien

15 October 1980
University City, Mo.

P.S. The Laws and Axioms that you'll run across in SEEDBED 7 are from Dickson, Paul, The Official Rules. New York: Dell Publishing Company, 1978.

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Some Geometric Investigations

Gracia Myers and Katheryn Midyett

It seems to be a common misconception that figures with the same perimeter have the same area and objects with the same surface area also have the same volume.

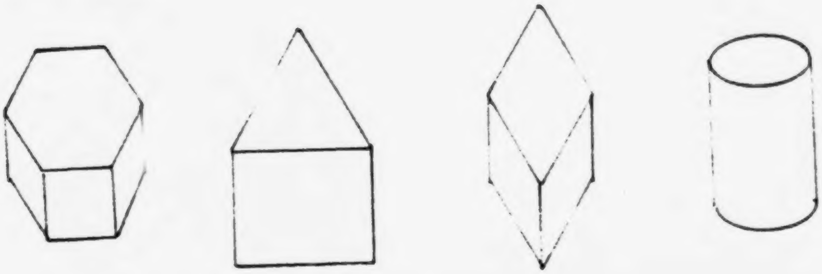
Ed de Moor showed us some classroom activities that can help your students begin to develop an ownership of area and volume concepts.

Give each child two pieces of stiff construction paper (8½ x 11). Have them roll one piece into a tall cylinder and tape the edges together.

Fill this with beans, rice, or a similiar material. Roll the other piece into a short cylinder and place it around the long one that has been filled.

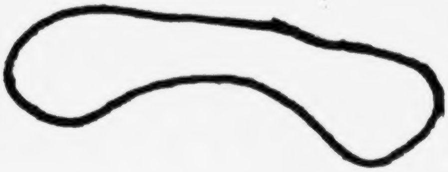
Now lift the tall cylinder and let the contents flow into the shorter cylinder.

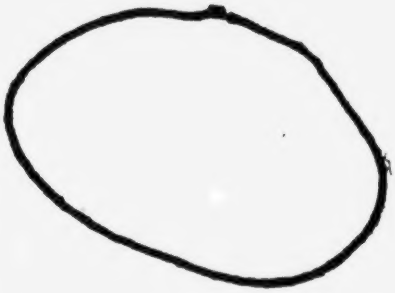
You can also try this with other shapes and fill each to see which has the greatest volume.



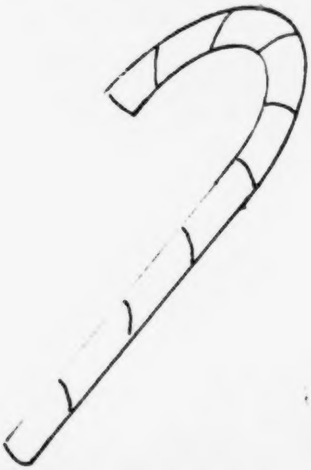
In ten years of teaching I have not seen any text book that does not approach--from the beginning--the teaching of area by teaching students to count the squares in a grid. (Do third and fourth graders need practice counting?) This is not only a bit boring, but it also fails to stretch the student's mind and give him a clear concept of what area is. Ed de Moor suggests that we approach the teaching of area with paper and scissors.

Give the student two pieces of string that are of equal length. Have them construct their own areas with these strings.

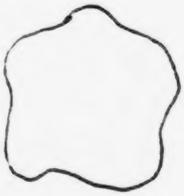




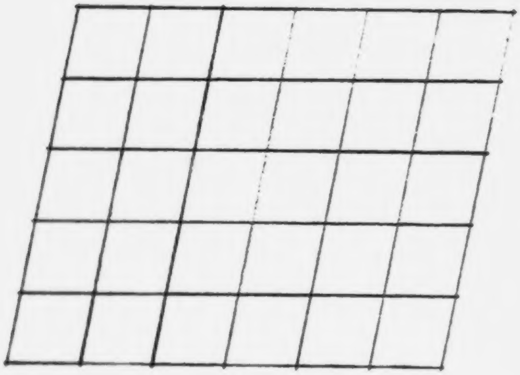
Have students cut out one shape (and if necessary cut it apart). By putting one on top of the other the areas can be compared. You can make it more interesting by telling them "this is a pizza" or "cookie dough" and asking which they would rather have.

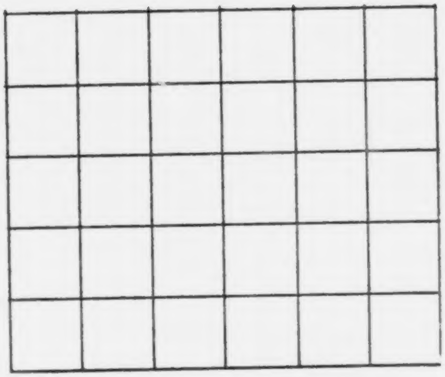


Both candies have the same thickness -- which would you rather have?



Continue to have the students cut the shapes apart as long as is necessary -- but gradually lead up to the "Ah-ha!", "Eureka!" method of teaching.





Which of these two pieces of plaid material is the larger? At least one if not a half dozen children will discover that they can count the squares of the plaid to figure out the answer. You can then continue with the text book activities and problems -- but with this kind of beginning your students will have a better feeling for area and volume.

Dude's Law of Duality--Of two possible events, only the undesired one will occur.

How Often?

Sandy Olson

As a novice in the area of "organic mathematics education I have some superficial observations which I should like to share. These are, at present, random and primitive but shall be pursued upon return to my home territory.

1. Teachers are human ⟷ children are human.
2. An underground is not unique to a military confrontation.
3. Teachers with "organic" beliefs are hungry for support, anxious for reform, eager to see and feel a change from filling a child's mind to nurturing those inherent childlike talents.
4. Persons of the "bent" of those congregated at SIUE this week are subtly different in their personalities than those traditional "pourers" of facts. (Think on this! I plan to.)
5. I am ecstatic to see and to be involved in a reform generated essentially by teachers of elementary mathematics.

Now some personal questions to me --

1. How do I become a carrier of this "organic disease"? I have observed it is communicable but what is its incubation period?
2. I have initially attempted to infect a nucleus of about 120 teachers. How do I with my employment restrictions provide periodic "booster shots"?
3. How do I make myself available for emergency injections?
4. Is this a process which can be hastened?

Further questions:

1. How often do we know of an activity suitable to what we are doing that we "scrap" for a fear of -- lack of time?

-- a new approach failing?

-- not being capable of following the avenues of thoughts which might be generated?

2. How often do we engage our children in an activity and move on at the point where it is only a drill activity?

3. Why are activities used as rewards for those who finish their "seat work"?

4. Why is Friday or the day before a holiday an activity day?

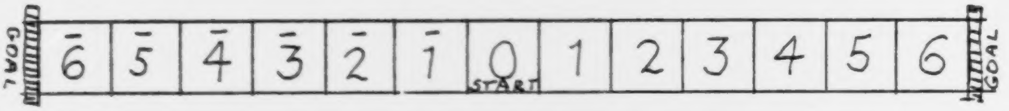
5. Are we using these for the wrong reason?

I have posed questions (problems) which I feel are open-ended, no unique solutions, hopefully soluble, and quite important.

Ettorre's Observation--The other line moves faster.

Dutch Soccer

Ed de Moor



Materials: Counter or coin and die

Rules: The first player moves to the right and the second to the left. Roll the die. The number that comes equals the number of steps. The first player who passes the goal line scores one point.

Example:

$$0 \xrightarrow{\overrightarrow{3}} 3 \xrightarrow{\overleftarrow{5}} \bar{2} \xrightarrow{\overrightarrow{1}} \bar{1} \xrightarrow{\overleftarrow{6}} \underline{\text{GOAL}}\,!$$

Comments: Children and adults like it.
They change the rules.
They do simple arithmetic.
The possibility of negative numbers!

Questions: Is this a fair play?
What is the average time length of a play?
(You can do a lot of statistics!)
(To solve it theoretically is a hard one, I think.)

Guess My Rule

Mary Steffen

Get three dice. Decide a rule like "the total is odd." Ask a partner to roll the dice and you tell whether or not the roll fits your rule. Your partner's job is to guess your rule.

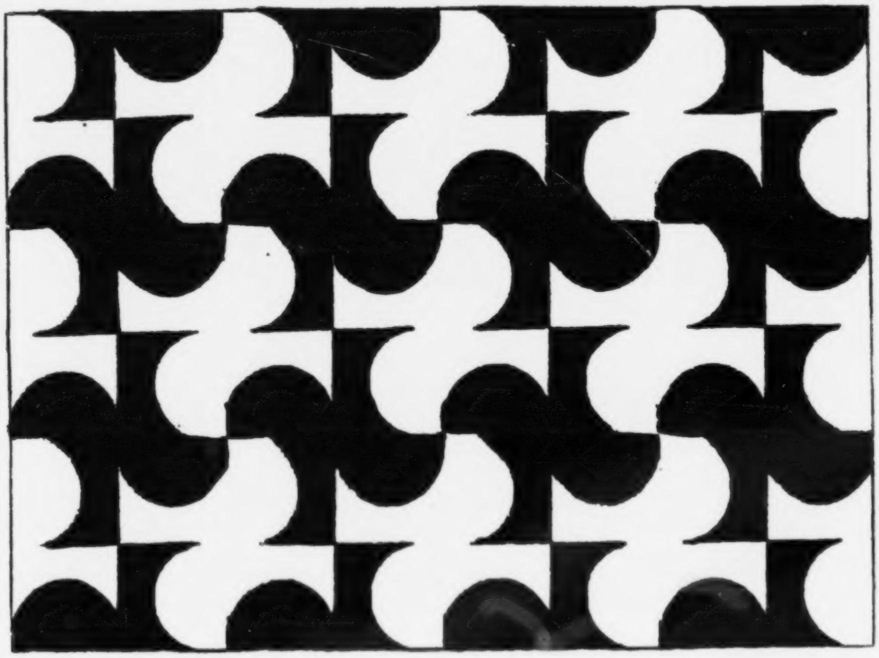
The following is an especially hard rule to guess, even though it uses only the math of a third grader. It involves order as well as operation.

Yes	No
235	115
112	236
334	446
116	346
223	113
236	123
	124
	444
	555
	222

What is the rule?

Birds

Bob Jeffrey



Area of the black "birds"?

Area of the white "birds"?

* *

Area

Bob Jeffrey

So now you know what area is!

Now suppose I am a man from Mars (green?) -- how could you get me to know what you know?

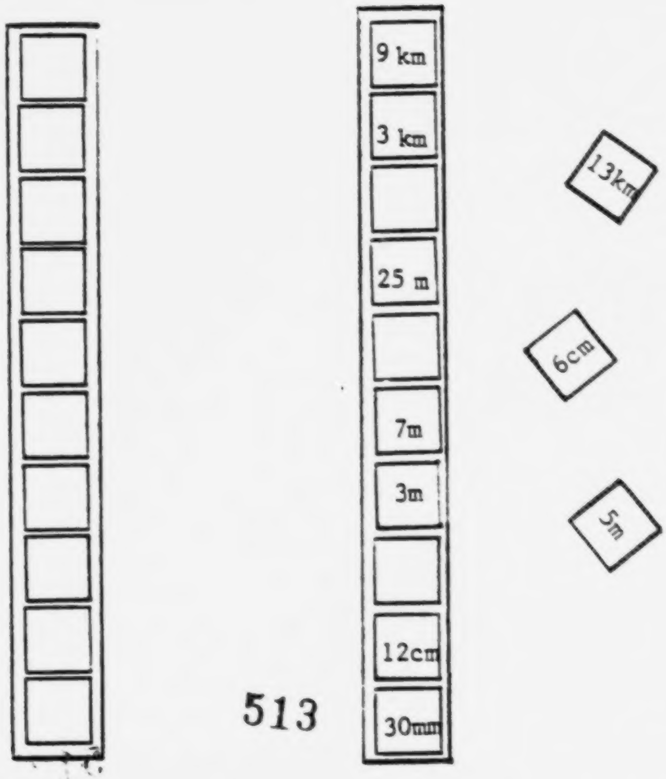
Metric Tens Patience

Barbara McAfoos

During the summer course at SIU, Bob Jeffery introduced the activity of Ten's Patience. I am going to bend this activity for my students to deal with manipulation of metric numbers.

Materials needed are 30 cards for each of the groups (millimeter, centimeter, meter, hectometer and kilometer) and a game board (4" x 22").

The cards are dealt out 10 at a time face down. They are turned up one at a time and placed on the game card so that magnitude increases from bottom to top. Once they are placed on the card they can not be removed. If upon turning up a card its proper position has been filled, just lay it to the side. See how many you can get in order. Seven would be great!



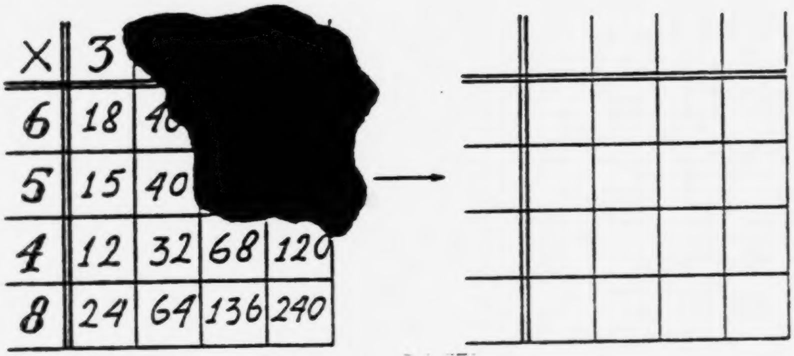
On Solving a Problem

Thomas C. O'Brien

The problem posed was this:

2 Constructing tables.

2.1.



×	3	[illegible]	[illegible]	[illegible]
6	18	[illegible]	[illegible]	[illegible]
5	15	40	[illegible]	[illegible]
4	12	32	68	120
8	24	64	136	240

▶ A dirty spot on the table. Repair it.

▶ How many 'sums' in a 4 x 4-table.

Then came this:

2.2. Fill in the missing numbers.

▶ How can you do it systematically?

×	3		7	
2		8		12
	9			
4				
	15			

And this:

2.3. ▶ Fill in the missing numbers (only integers).

▶ How many solutions?

×	3		7	
		8		12
	9			
4				
	15			

×	3		7	
		8		12
	9			
4				
	15			

×	3		7	
		8		12
	9			
4				
	15			

×	3		7	
		8		12
	9			
4				
	15			

All of which led up to the problem that grabbed me. Actually I had messed with the problem in writing the number puzzle book for Cuisenaire, but in the pressure of deadlines I never got around to a systematic solution. Here is the problem:

2.5. ▶ Design a multiplication table yourself with missing outside numbers.

Try to leave out as many numbers as possible.

×				

×				

▶ **What is the smallest amount of numbers you have to start with for finding one unique solution. (A hard one).**
Can you also generalize this discovery?

Being a true Polyan (or at least an apprentice Polyan, after George Polya, the Hungarian Patron Saint of problem solvers). I decided at first not to work with the original problem. "Let's go to the simplest case," said I. "What's required for a 2 by 2?"

A first stab looked like this:

X		
		6
	5	3

Clearly this is unique, assuming that the outside row entries and columns have no duplicates.

X	5	3
2	10	6
1	5	3

The problem was that the original three number grid was not generalizable. On the one hand, the original 5, 3, 6 yields a unique solution, but another three numbers - say 4, 6, 18 - would not.

X		
		18
	4	6

Moreover, certain selections of those numbers would yield no grid at all.

X		
		7
	4	5

(As I write this in retrospect it's not clear why I decided to work only with "inner" numbers.)

It is clear that I was on to something, however non-generalizable. The next note on my page reads

2 by 2 ⟶ 3 entries

Now it was time for a 3 by 3. Clearly,

X			
	2	8	10
		24	
		32	

at the same time has too many numbers (I suspected) and yields a non-unique solution. Let's dig in. So I tried:

X			
	2	3	5

Here the first column entry is determined; it is 1. And given that the top outside numbers fall out, now all that's needed are two vertical entries (consistent ones) which would determine the remaining outside column entries.

x	2	3	5
1	2	3	5
		3K	
		3m	

Happy with this thinking, I continued the list as follows, quickly testing that completing the top inside rows for a 4 by 4 would need 7 inside numbers - 4 primes across the top row and 3 consistent vertical numbers.

2 by 2 → 3
3 by 3 → 5
4 by 6 → 7

And, "in general" for this special case,

n by n → n + (n - 1)

Oops, it occured to me at this point, my original special case was not the simplest one of all. In fact, a certain choice of numbers yields even more quickly determined results:

X		
	1	
		4

X			
	1		
		4	
			9

X				
	1			
		4		
			9	
				25

That, for sure, is the minimal solution. The general solution I will leave for you. Make the issue your own and play around with it.

* *

Unique Solution With Four Numbers

(Degenerate No. 3)

Shirley Casey

X				
	1			
		15		
			21	
				55

If a number may appear no more than once on the same margin

and

If a unique solution is defined as that which (no matter the arrangement) will produce only one set of 16 products from the 8 possible factors.

Combo

Sandy Olson

Materials: Deck of 55 cards with all possible number pairs, using digits 0-9.

```
0  1  2  3  4  ---  9
0  0  0  0  0       0

1  2  3  ---9
1  1  1     1

2  3  4  ---9
2  2  2     2

9
9
```

Deal three cards to each player (3-5 players). Place deck in center. Turn up top card. The first player then makes all possible combinations of the two numbers on the upturned card. Any operation that produces a whole number answer is okay.

Next he looks at the cards in his hand and the possible combinations there.

Example:

Turned up	Values	In hand
7 3	10 4 21	6 8 2 2 2 2

6 - 2 = 4 = 7 - 3
2 + 2 = 4 = 7 - 3
8 + 2 = 10 = 7 + 3

He removes from his hand all cards that can make a combination equal to one made by the upturned drawn card and places them on his trick pile. The player then draws enough cards to make a total of three cards in his hand.

A new card is turned up.

Other players take their turns and play continues until the stack is gone. The player with the most cards is the winner.

Variation:

If a player has no match he must draw until he gets one. The winner is the first to be rid of his cards.

Law of Computability Applied
to Social Sciences--If at first
you don't succeed, transform
your data set.

Factor Football

William Breden

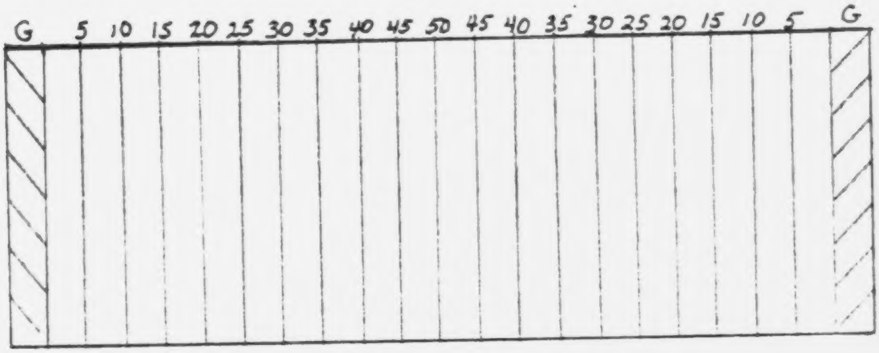
Materials: 2 players and 2 dice.

Player "A" rolls his dice and finds the sum. If one of the numbers is a factor of the total, player "A" moves the ball from the fifty yard line one line toward the opponent's goal for each time it can be factored. (Example: 2 + 4 = 6; 2 is a factor of 6 three times. Player "A" would move three lines toward player "B"'s goal.

Player "B" then takes a turn, hoping to pull the ball back toward the fifty yard line.

A player wins by crossing the goal line first.

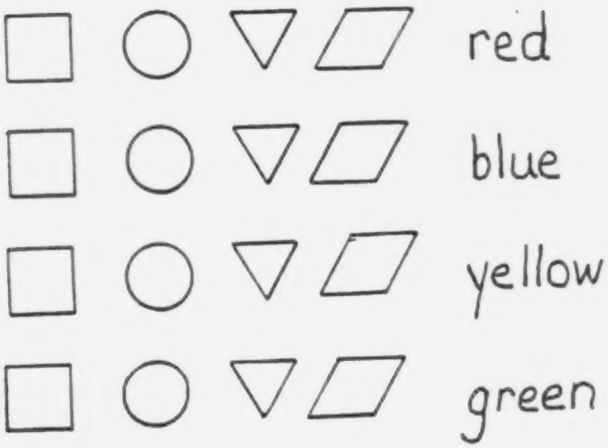
A penalty is assessed when a player gives the wrong answer and is caught by the opponent. The ball is moved back to the original place. The player is penalized two lines or 10 yards.



Attribute Blocks

Joan Barnes

Sixteen blocks of the same size are needed for this activity. Four different shapes will be used. Each set of shapes will have a different color.



Arrange the blocks in four rows across and four rows down. Do not repeat the same color or shape in any row. How many ways can you arrange the blocks without repeating a color or shape?

About Education
Study Suggests Texts Are Often Inadequate

Fred M. Hechinger

The nation's public schools spend about $1 billion a year on textbooks and other teaching materials - much of it wasted. This, at least, is the conclusion of a federally funded study by a group concerned with the quality of educational products.

The two-year study of about 300 fourth and tenth grade pupils found that the majority of the students either knew most of the content of their textbooks beforehand or gained little after using them.

The study was conducted in six Long Island school districts by the Educational Products Information Exchange Institute, a non-profit organization that looks after the interests of consumers of educational materials. It was financed by the National Institute of Education, a Federal research agency.

Sixty percent of the fourth graders in affluent communities achieved scores of over 80 percent in a test on the contents of their mathematics text that was given to them at the end of the previous school year - before they had used the text. Seven percent of the fourth graders from poor communities also scored 80 percent or better under the same conditions. However, 87 percent of the disadvantaged youngsters, who scored only 38 percent or less at the start of the year, showed little or no gain after using the book during the year.

Similar findings were reported on tests of textbook content in fourth and tenth grade science and 10th grade social studies.

"Aside from the question whether these textbooks should have been purchased," said P. Kenneth Komoski, the director of E.P.I.E., "there are two more basic questions: Why do so many schools fail to assess the learning needs of students adequately? Why do the producers of these materials fail to test and label their products in ways that would help schools achieve a better materials-to-learner fit?"

When schools fail in selecting teaching materials that match the needs of the students, Mr. Komoski said, "the learners are the losers."

Mr. Komoski conceded that it would be unfair to place all of the blame for children's failure to learn on teaching materials, which include records and audio-visual materials. Good teachers, he said, know how to put the wrong materials aside and proceed on their own. Nevertheless, he said, too few teachers are given a choice of books and many feel "stuck" with those that they are given.

Teaching materials play a crucial role in the teaching process, he said. Ninety percent of classroom time is devoted to the use of such materials by students and teachers, according to the institute's research, which is corroborated by the National Science Foundation.

"Our present study suggests that a good deal of the dollars and hours are being wasted because of poor selection by those who buy the products and inadequate product development and labeling by those who sell them," Mr. Komoski said.

James R. George, E.P.I.E.'s research director, said that although textbook publishers do a great deal of pretesting of their products, such testing is largely confined to determining "if the kids can handle it"- that is, to comprehend the words in the text rather than the content.

What makes these findings particularly significant, Mr. Komoski said, is that teaching materials tend to determine what happens in many classrooms, even though "neither the sellers nor the selectors" of these products are very clear about their use.

Textbook editors, Mr. Komoski said, would like to get better feedback. "The tragedy is the lack of a real response from the marketplace," he said.

Mr. Komoski also stressed that these crucial materials are being produced by fewer and fewer publishers, who thus exert greater influence on the curriculum than local school districts.

Although the E.P.I.E. study also identified examples of "some excellent efforts by a few publishers" to adjust their products to the learners, Mr. Komoski charged that "schools continue to spend tax dollars on untested, unimproved materials."

Mr. Komoski stressed that "one can't generalize about publishers." Some publishers that do mainly market research for some of their textbooks also have departments that insist on effective feedback for books for which they are responsible. He said that publishers who developed materials for the handicapped tended to do a superior job in responding to the learner. "They have a very critical audience out there and they respond," he said.

But, he said, some of the most successful companies devoted most of their efforts to packaging, which he described as " a more potent influence on sales than careful attention to curriculum design or instructional effectiveness He said that the few competing texts in such basic subjects as reading, mathematics, science and social studies, were found to be practically identical except in appearance.

Mr. Komoski said that fewer than 5 percent of over 120 teacher training institutions surveyed offered courses in the selection of teaching materials.

The educational products group and the National Institute of Education are organizing the first large-scale training programs to teach local school districts the essentials of textbook selection. The goal is to incorporate such skills in the regular training of teachers and school administrators. Mr. Komoski offers such a course at Teachers College of Columbia University.

In addition, an in-depth project to improve textbook selection will begin in the 1980-81 school year as part of New York City's School Improvement Project, and in some school districts in Illinois and Oregon.

As buyers of textbooks become more sophisticated, Mr. Komoski said, the producers may have to pay more attention to content than to "new and improved" labels on the package. He said that the purpose of his group's studies was not to abolish textbooks or to diminish their use but to give them an educational validity they now often appear to lack.

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*This article is reprinted in its entirety from The New York Times, Tuesday, April 8, 1980.

Ways to Make Ten

Mary Steffen

Pose this question for your math class: How many ways can 10 be made using only addition?

Paper and pencil may be preferred by some. Others may want to use Cuisenaire rods or other counting tools.

Later ask, "How do you know you have them all? Does organizing help? What is the greatest number of numbers you can use to make 10? The least? Can every number in between be used to make 10? How many each?"

Some controversies that may occur:

1. Do all these count? 1 + 2 + 7, 7 + 1 + 2, and 7 + 2 + 1, etc., or only once?
2. Does 0 + 10 count?
3. Does 0 + 0 + 9 + 1 count?

What questions can you think to ask? What questions do children themselves ask?

Allen's Distinction--The lion
and the calf shall lie down
together, but the calf
won't get much sleep.

Major Problems of Mathematics Education

Professor dr. Hans Freudenthal
I.O.W.O. Utrecht

Here is an excerpt from Hans Freudenthal's plenary session address at the Fourth International Congress on Mathematical Education, Berkeley, August 1980, reprinted here with the permission of Professor Freudenthal and of Alan Bishop, editor of Educational Studies in Mathematics. The full paper is to appear in the May 1981 issue (Volume 12, No. 2) of Educational Studies in Mathematics.

In the preceding I stressed

observing learning processes

against

testing learning products.

Amongst the learners I mentioned I forgot one, the biggest one. Mankind too is a learner. Observing its learning process is what we call history. How can the individual learner profit from knowledge about the big learning process of mankind? Rather than from its detail he can profit from the fact as such. Each stage in the growth of mathematics meant:

knowledge acquired by insight

transformed by

schematising and memorising (or call it, codifying)

into

skills and insight of a higher order.

Let me explain by a few examples what I mean by schematising.

A problem of long standing:

A farm with chickens and rabbits,

20 heads and 56 legs;

how many chickens and how many rabbits?

I am sure you will solve it by insight. But as early as Babylonian antiquity one knew the schematism of a pair of linear equations with two unknowns to solve this kind of problems, and in more recent times this schematic insight has been anew schematised by the rule: Put the unknown numbers x and y, write down the connecting algebraic relations, and solve them by algebra. The most modern schematisation of this idea is vector space.

Clumsy algebra by insight was schematised by Vieta and Descartes' formal methods, and this process of schematising still continues in modern algebra. Calculation of areas, volumes, gravity centres, and moments, which once required the genius of an Archimedes-and even harder problems-are today within the grasp of our freshman, thanks to Newton and Leibniz' schematising infinitesimal methods in what is known as Calculus.

But let us explain it in an even more elementary way. As early as written sources can remember, counting was schematised by introducing higher level units such as 5, 10, 100, 1000, and as early as reckoning was invented, it was schematised by a positional idea: higher level units materialised by counters on the abacus. Schematising arithmetic proceeded one step further by transforming

sets of counters into digits,

and

the hardware abacus into a written one, written into sand or on paper, from which by a progression of schematising our present schematism of columns arithmetic arose.

Let me illustrate this process by a modern didactical version, a few sheets that need hardly any explanation.

The schematisation of packing units,

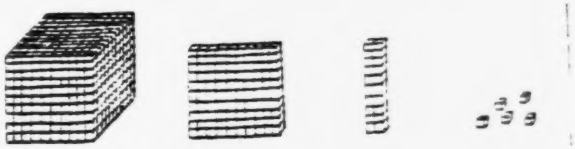


Fig.1

the positional arrangement transformed into the positional abacus-the schematisation that makes each bead worth its position,

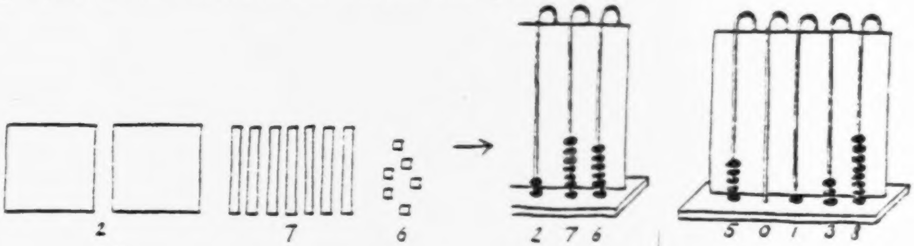

2
7
6
2 7 6
5 0 1 3 3

Fig.2

the schematism of changing tens of units into higher ones,

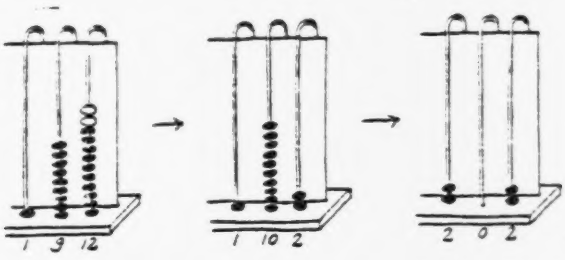

1 3 12
1 10 2
2 0 2

Fig.3

the schematism of the drawn and written abacus and of addition,

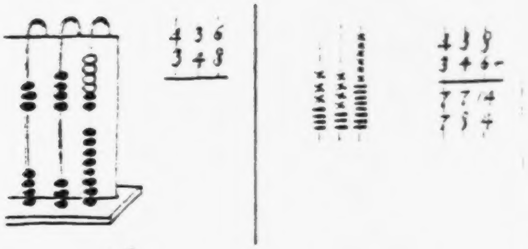

4 3 6
3 4 8
4 3 9
3 4 6
7 7 14
7 3 4

Fig.4

again schematised by the position card,

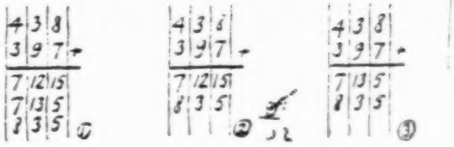


Fig.5

the last step before the final schematisation of the usual column addition.

History of mathematics has been a learning process of *progressive schematising*. Youngsters need not repeat the history of mankind but they should not be expected either to start at the very point where the preceding generation stopped. In a sense youngsters should repeat history though not the one that actually took place but the one that would have taken place if our ancestors had known what we are fortunate enough to know.

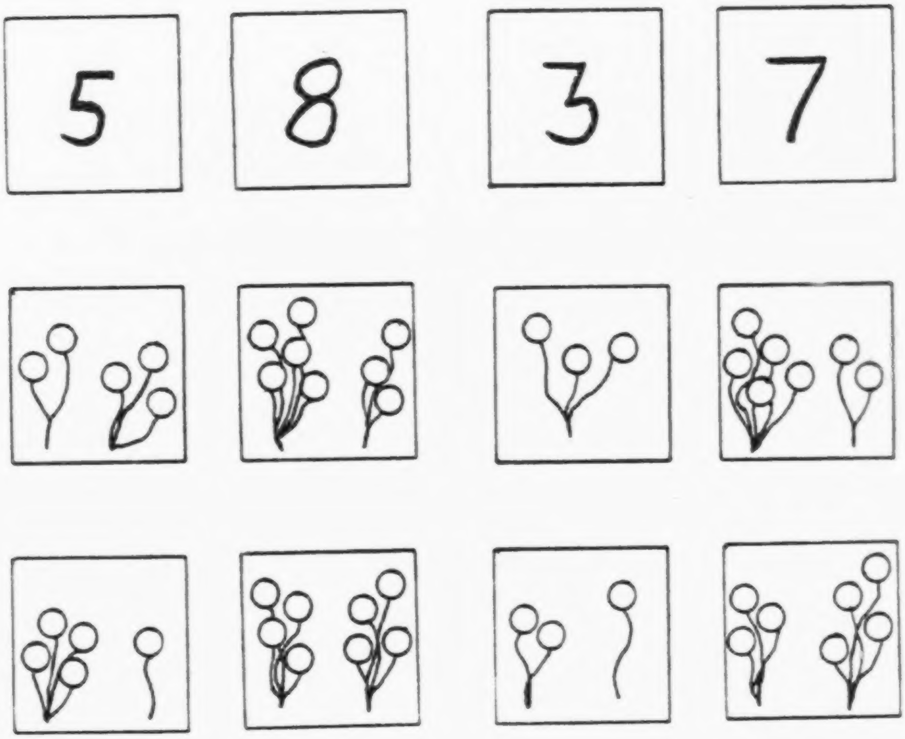
Schematising should be seen as a psychological rather than a historical progression. I think that in mental arithmetic of whole numbers we can fairly well describe schematising as a psychological progression or rather as a network of possible progressions where each learner chooses his own path or all are conducted the same way. Quite a few textbooks witness efforts to teach learning the traditional algorithms of column arithmetics of whole numbers by a progression of schematising steps though I am not sure whether their ideas are supported by actual learning and teaching. In teaching fractions, decimal numbers, algebra, calculus I see little if any attempts at progressive schematising. The idea that mathematical language can and should be learned in such a way-by progressive formalising-seems even entirely absent in the whole didactical literature.

How Many Ways?

Joan Barnes

This game is suitable for two to five players. Deal cards with numerals 1 through 10.

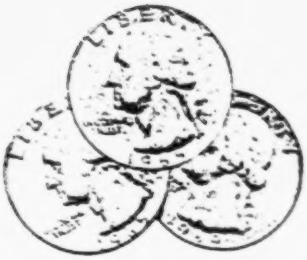
Draw 15 cards from a stack of cards with balloons showing all of the combinations for making the numbers. When a card is shown, the child who has the numeral which shows that number claims the card and places it below the proper numeral. The child with the most cards wins.



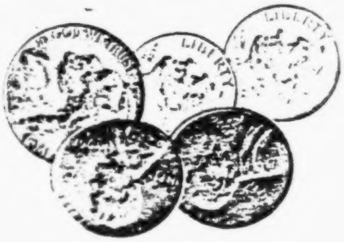
Using Exact Change
or
Can You Count The Ways?

Ed de Moor

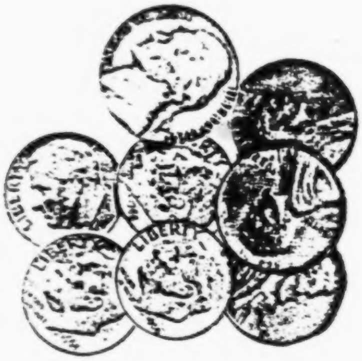
75¢



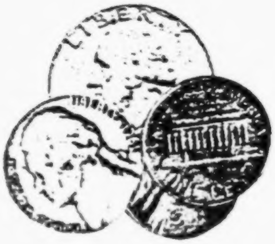
27¢



48¢



32¢



You may use pennies, nickels, dimes and/or quarters. For example, thirty-seven cents could be 37 pennies; three dimes, one nickel and two pennies; etc.

How many different ways can you make the amount?

What is the smallest number of coins necessary to make the amount?

What is the largest number of coins that could be used?

Could you make the amount with 13 coins? If so, is there more than one way?

Let —

M = largest number of coins

m = smallest number of coins

Can you make the amount using the number of coins for each integer between M and m?

The View Box

Helen Miller

Children around the age of four enter kindergarten with an intuitive three-dimensional experience. It is possible to enlarge upon this intuitive experience and to begin making children more conscious of a few elementary geometric concepts by having them make a view box.

Begin by creating some observational activities.

The teacher asks questions such as:

1. "Look at the teacher's face. Can you cover it with the tip of your finger?"
2. "This is a piece of cardboard with a hole in it. How must it be held and where must you stand in order to see the picture on the wall?"
3. "The truck we can see from the 5th floor is no longer than my index finger."
4. "Why is that airplane going so slow?"
5. "What can you see in the room when looking in from the outside?"
6. "Where do shadows come from?"
7. "What will the shadow of this shape look like?"

The teacher asks each child to bring an empty shoe box with a lid to school. She tells the children that they are going to make a view box. She explains that the children must make something inside the box and look through a peep hole in the end of the box.

The children then proceed to make a hole in one end of the shoe box.

"What do you see when you look inside?"

"It's dark in there."

"Let's take off the lid, then it won't be dark."

"But then you don't need the hole."

"Cut a hole in the lid."

The children decide to cut the hole in the lid and to cover the peep hole with colored cellophane.

As they begin to make the figures for the box, some cut out very small figures, while others cut large figures.

It is necessary to use heavy paper and an extra edge must be made in order for the figures to stand.

As the children work, they find that the figures must be short enough to fit into the box and proportional in relation to each other. The figures should not be fastened down until the children have had an opportunity to experiment with the placement and size of the figures.

One of the children in viewing his figures found that they were all facing the wrong way. He turned them around but did not take into consideration the fact that the smallest and largest figures must be changed in order to see all the figures.

"What would you see if the peep hole were in the other side of the box?"

"What could you see if the peep hole were in the bottom of the box?"

The children find that putting things into perspective takes a great deal of planning and manipulating when they have to do it with a paper and pencil.

Construction of the view box involves mathematics at various developmental levels. Concepts that the children are developing as they work are: those of size, place, change of view, place of objects, change in eye-hand coordination, visibility and invisibility, and color concepts.

Tens and Ones

Joan Barnes

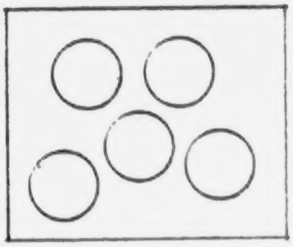
Each child selects a game board such as those shown below. Fifty cards with 0-10 objects are placed face down on a table. Players take turns drawing from the stack of cards. If they can use the card to complete an equation, they place it on the proper space on their board. If they cannot use the card, it is passed to the left until someone can use it. If no one needs the card, it is placed in the discard pile. The player who fills his card first is the winner, as in Bingo.

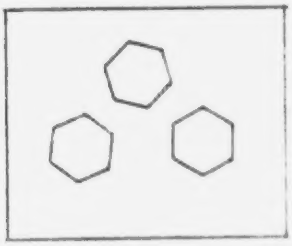
Examples of playing cards:

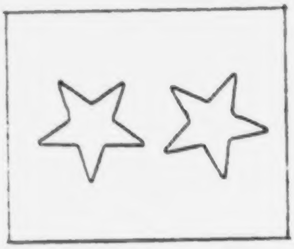
$10 + \square = 16$	$10 + \square = 17$
$10 + \square = 19$	$\square + 10 = 15$
$10 + \square = 12$	$10 + \square = 11$
$10 + \square = 14$	$\square + 10 = 13$

$10 + \square = 12$	$10 + \square = 18$
$10 + \square = 16$	$10 + \square = 0$
$10 + \square = 11$	$10 + \square = 17$
$\square + 10 = 19$	$10 + \square = 15$

Examples of object cards:







A Bent Bend

Ed de Moor

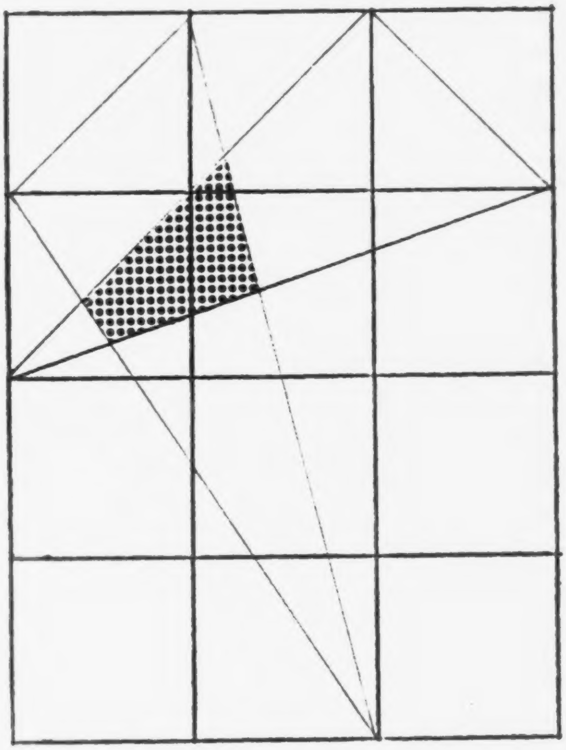
?	3	4
1	3	4
7	7	7

What operation or combination of operations is at work here?

One Tiny Problem

Thomas C. O'Brien

Find the area of the shaded figure.



Recent Piagetian Research

Hermina deZwart Sinclair

Here is an excerpt from a forthcoming Teachers' Center Project publication, "Young Children's Thinking" by Mimi Sinclair. In the next issue of SEEDBED we hope to make available excerpts from Mimi's plenary session address at the Fourth International Congress on Mathematical Education, University of California at Berkeley, August 1980.

Now the newer line in this type of research is that now these structural periods have been well investigated it becomes possible to look more at the process, that's to say the way children actually look at problems and deal with them across the stages. One can look at something like contradiction. How does a child deal with contradiction in the early ages and how does he deal with contradiction in the later ages? Or generalization, which is a process that goes on in babies, goes on in young children, goes on in adolescents. According to the structure of thought in the various big periods, generalization takes on different forms and different functions.

I think that all this is probably not very comprehensible unless one is really inside the theory, so I think the best thing I can do is give an example of work with Piagetian colleagues in Paris and with Genevan co-workers. We have been looking at the development of hypothesis making. I have a certain number of examples which I would like to tell you about. The earliest examples are from children who are 20-21 months old, very young babies indeed, then some from 5 year olds, then some from 8-9 year olds, and then from 13-15 year olds. Let's see in what sense one can say that hypothesis making is already there at the very early ages and in what sense it has a different nature--is not the same approach to a problem--as hypothesis making is at the age of 14-15.

To make a long story short, in Paris with my colleagues Mira Stanbach and several others who work in a pedagogical setting, we have been looking at babies between the ages of 9 months and 24 months playing on the floor usually (and sometimes around a table) with certain collections of objects.

The situation I would like to talk to you about is a situation where the children have a rather odd collection of stuff. The odd collection is composed of materials that can easily be transformed--for example, some cotton wool, a string, an elastic. There are also things that are pierced--a big wooden ring, some wooden beads, and some beads made of papier-mache. Also, some spaghetti (uncooked), two tubes open at both ends, (the tubes cigars come in), and a couple of sticks.

A side issue of the situation is that we filmed the children longitudinally once a week--there are about 15 subjects that are filmed week after week-- and there are two different situations, 1) where the child is alone and 2) where there are four of them together. Another side issue I just would like to mention is that now that I have seen this in a lengthy program my views on what in Paris are called "creches" (nurseries) for very young children have greatly changed. I think there is something babies under the age of two get out of being with peers which they do not get out of being inside the family. Perhaps at the end I could get back to that.

Back to hypothesis making. Given this collection of objects, and given the fact that the child can do what he likes with the objects (and all we do is film; there is no intervention. Of course, there is somebody behind the child in case the child starts swallowing stuff or hurts himself) all sorts of interesting things happen. The particular behavior I wanted to describe takes place when a child picks up one of the tubes I described. From the age of 14 months onward one of the most general activities of all babies is putting things into other things and exploring certain objects that are made to be containers as against others that seem to be made to be contents. Whenever there is a cup or a box you will see the 13-14 months old start putting things into that.

Now there is no box in our materials, but there are these pierced objects and by the time they are 14 months old they all start putting things through the pierced objects. Their behavior with tubes--this has been seen in quite a number of them and it struck us as something rather extraordinary--is to take up one of the tubes and take up a stick and first of all try to put them together as if they had two sticks and they make sure the two were something different. Then they put down the sticks and put their finger in one side of the tube and put their finger in the other side of the tube. (What they don't do is what they do much later, beyond 3 years old. They don't look through the tube to see if the whole thing is pierced. It seems to be sufficient to notice the two holes.) Thereupon a stick is taken up and put through the tube. The stick happens to be slightly longer than the tube, so it comes out a bit. It happens almost every time that when they are doing that they don't hold the tube completely horizontal so the stick slides out and falls to the floor. Now this is a very interesting event to a baby. When it first happens, it surprises him. There are a certain number of behavior indications that tell us that this is a surprise. It's a surprise in the right sense because it amuses him and he wants to reproduce it, so he picks up the stick again and holds his tube the same way, and puts it through again. Now before letting go he already looks underneath, where he now knows it is going to come out. And he is very happy when it does. What we often see is children holding the tube in the same oblique way and pushing the stick through at least 6 or 7 times. Now this is a hypothesis on reality. Reality, if you make the conditions right, is going to reproduce itself. There is a certain regularity.

Things are--I don't dare to say "lawful"--but they are regular. They don't do just any old thing at random.

What is more interesting: after having established this regularity, the child will put his hand the other way around and with great trouble put a stick on the other side. Now he is looking for something before having seen it. He already knows, apparently, that the stick is going to come out the other side. So you've got what looks to us as the beginnings of experimentation in "hypothesis making" and "physics". These words have to be used in quotes. the babies establish regularity by recognizing an interesting event and reproducing it. Then when they vary the conditions, they already have some anticipation of what the conditions are going to produce because when they turn their hand around they look this way (demonstrates) instead of looking at the place they looked at first.

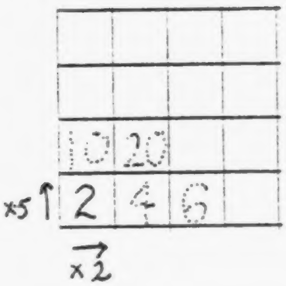
"Young Children's Thinking" is available from the Teachers' Center Project at the cost of printing.

Allen's Axiom--When all else fails, read the instructions.

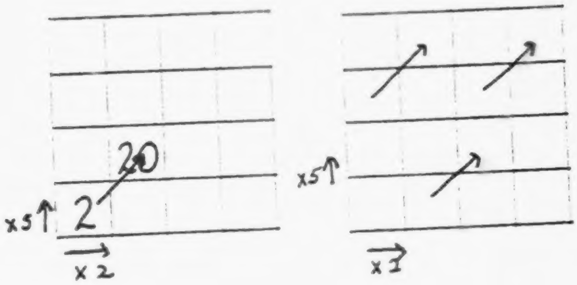
Diagrams

Ed de Moor

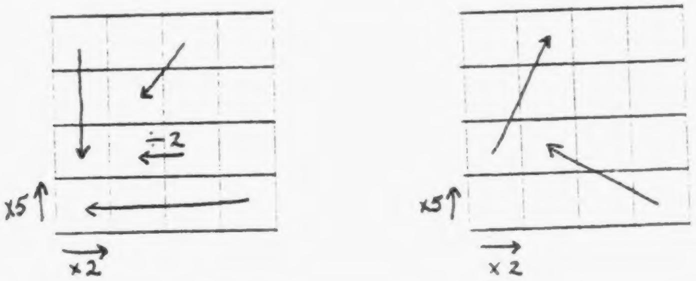
1) Complete.



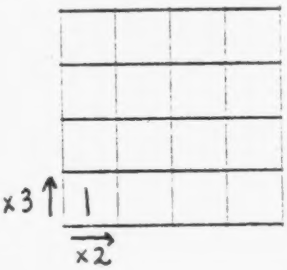
2) What does the arrow mean?



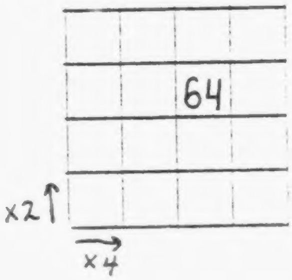
3) What is the significance of the arrows?



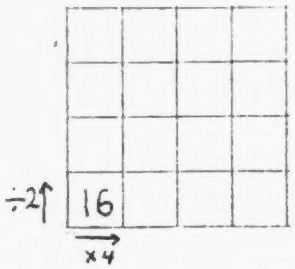
4) How many multiplications?



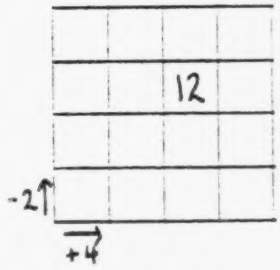
5) Complete this diagram!



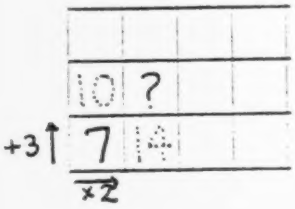
Complete.



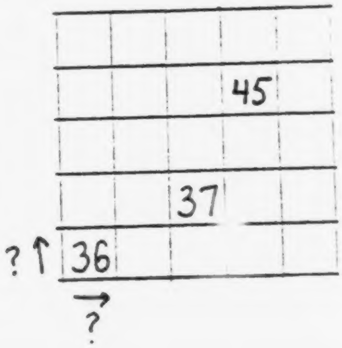
7) Complete.



8) What is going wrong?



Addition and/or subtraction



Find out the meaning of the basic arrows. (You can do it without algebra!)

Fround's Law--A transistor protected by a fast-setting fuse will protect the fuse by blowing first.

I Have A Friend

Bob Jeffery

I have a friend who --

--loves apples but hates pears
--loves Italy and America but hates Poland
--loves Ursula but hates Sally
--loves acting but hates dancing
--loves us but hates ours
--loves in but hates out
--loves uncles but hates aunts.

* * *

I have a friend who --

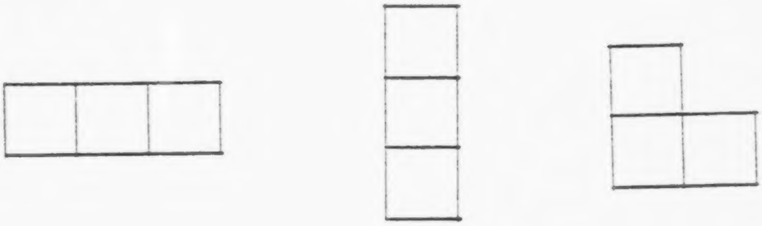
--loves 6 but hates 7
--loves 30 and 24 but hates 32
--loves 12 but hates 9
--is not too sure about 0.
(but Sandy Olson says that 0 is okay!)

Area Activities for Kindergarten and First Grade

Joan Barnes

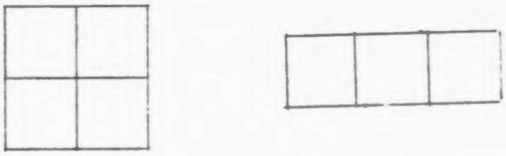
Is the area the same?

How can you tell?



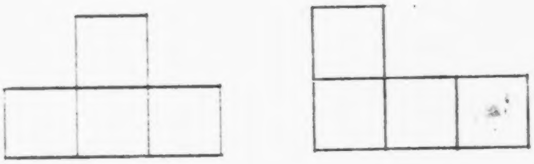
Are these areas the same?

How can you tell?



Are these areas the same?

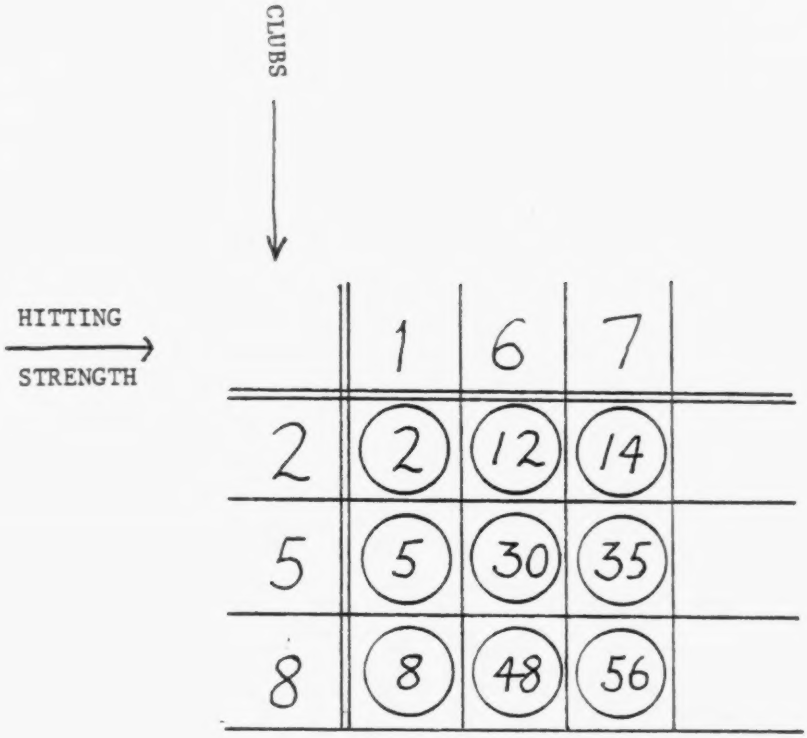
How can you tell?



Have the children cut or color graph paper showing the number of ways they can arrange 4 squares, 5 squares, 6 squares, etc. Each square must have adjoining sides. Children enjoy making pictures from these squares after they have cut or colored them. Animal pictures are fun..

Golf Multiplication Tables

Ed de Moor


CLUBS
HITTING
STRENGTH

	1	6	7	
2	2	12	14	
5	5	30	35	
8	8	48	56	

Length

1 = 5 - 2 - 2

2 = 2

3 = 5 - 2

Can you get any length?

General Position Statement on Evaluation

George E. Hein

1. Children go through stages of physical, mental, emotional and social growth, and it is important to know where the children are, at a given point, and what one may expect next. In many instances, these stages can be expressed in a quantitive manner. There is no point in saying that Susan is short or that she is just so high; one can readily report that she is 42-inches tall. Likewise, abilities to read or compute can be described with some precision. However, it is always important to recognize just what those measures mean. Being 42-inches high at age six is a fact, but one that has little relation to worth or general ability, or even to how high Susan can jump or whether she can run fast. Likewise, a sight vocabulary score is just that and nothing more.

Perhaps most important to stress in discussion of quantitative measurement is that we are interested in these measurements because of what they tell us about that child, not because they permit easy comparisons. This point is at the heart of all discussions about evaluation and measurement. Any statement about a child's achievement and level tells something about that child. So first and most obvious, evaluation results should not be formulated in terms of averages, but in terms of individual results. Or, to put the same statement in somewhat more technical language, what is interesting in any group measurement is not the mean but the variance.

It is also important to remember that in the assessment of any evaluation effort, what has actually been measured must be clearly stated. A measurement of height or weight is direct and we know what it means; many educational evaluations are not. For example, students who can read quite well and comprehend what they read, may receive a low score on a reading test if they do badly on some technical sections, such as blending, syllabification auditory discrimination (Allen, 1974).

2. Evaluation practices must respect the setting in which the educational effort takes place. That is, it is necessary to adapt the evaluation to the program rather than *vice versa*. When the educational endeavor is one which advocates learning through interaction with the world and through social interaction, it becomes particularly important that the measurement of children's growth also involves the 'stuff' of the world and permits social, cooperative interaction. The whole process of evaluation must also take into account the effect of the testing itself on the school setting and on the whole program. This is important both in the measurement of children's progress and in the evaluation of programs.

3. All evaluation efforts should recognize the distinction between saying and doing, between verbal knowledge and ability to use information. If I want to find a good mechanic for my car, I usually don't ask the mechanic to describe the internal combustion engine. If I want an electrician, I don't ask for a definition of electricity; I want to find out about the work of these people. Similarly, evaluation of children's work should take into account the doing of that work, not merely descriptions of it.

4. The value of any evaluation is in direct proportion to its usefulness, to how much it can help a child's education. If there is any measure of what a child can and cannot do, then this should be in a form and at a time when it can directly assist the people who are working with that child.

To summarize, any evaluation of children's performance, whether quantitative or qualitative, should stress the individual results rather than make comparisons, express these results in a manner that is useful to the people involved, relate it to the particular educational setting, and recognize that children are complex beings with a wide set of attributes and influences.

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*This article is reprinted in its entirety from An Open Education Perspective On Evaluation by George E. Hein. North Dakota Study Group on Evaluation, c/o Vito Perrone, Center for Teaching & Learning, University of North Dakota, Grand Forks, N.D.: 1975.

So What Is Basic? (Or Meet Me In St. Louis)

Bob Jeffery and Ed de Moor

* * *

Who is this Ed de Moor? I think that he will be a serious-minded Dutchman and probably lacking in humor.

* * *

Who is this Bob Jeffery? I think that he will be a very old Englishman.

* * *

It is just like going to a new school. Yes, we know some of the kids (or we have heard of them before) -- Tom, Shirley, the "Missouri kid" (Mary)-- but we are still rather apprehensive.

We have basic problems before we start -- language problems, communication problems, problems of finding our way around, and many more. Perhaps solving problems is basic -- but wait ...

We discover what is really basic when we go to the Ferguson-Florissant District for an evening meeting. We expected to find some common ground at SIU (we didn't come here by chance), but now we find more smiling faces, encouraging nods, interesting questions. Nice people are part of a NETWORK. They have shared thoughts with Tom, talked with Mary and little Susan has been to an ATM conference in England.

And now we know what is basic. GROWTH IS BASIC -- for kids, for teachers, for all and it is happening here.

LONG LIVE THE NETWORK!

Editor's Note: In midweek of the summer course Ed and Bob did a session -- separate from the course -- with teachers from the Ferguson-Florissant schools. Next day they wrote up their impressions in answer to the question, "What is basic?"

Using Tables In Math Education

Annemarie Garcia

During the Teachers' Center Project summer course, Ed de Moor from the Dutch Institute for the Development of Mathematics Instruction did a section on using tables in math education. Using tables can be an extremely healthy and worthwhile exercise for our math education. Students can be taught that a table can be a very systematic way of storing data. For teachers, tables can be a fantastic alternative from pages and pages of ditto sheets. One simple table can take the place of rows of problems.

Here are some simple tables from Ed de Moor's problem book which can be used with younger children. Try these with children and then let the children make their own and exchange.

×	2	5	3	7
4	8	20		
8				
6				
9				

Multiplication Table

+	2	5	3	7
4	6	9		
8				
6				
9				

Addition Table

↶−	4	3	2
7	3	4	
6			
5			

Subtraction Table

*Please note the direction the subtraction table must be computed to avoid integer answers for younger children.

Bending......

Here are some tables which can be used with junior high students or beginning algebra students.

X	1	-2	6	-10
3	-3	-6	18	
4				
-5				
0				

Multiplication Table
with directed numbers

↶−	6	-5	-4	3
-3	-9	2	1	-6
2				
-1				
0				

Subtraction Table
with directed numbers

X	a^2	b^2	c^2	d^2
ab	a^3b	ab^3		
b				
cd				
a^2b				

Multiplication Table
with variables

Here are some even harder problems where the student needs to fill in all missing squares. (A nice exercise for solving equations.)

X	1			
	-1	-2		
		-3	-4	
			-5	-6
				-7

Multiplication Table with Rational Numbers

Do all the tables have to have a solution? This one does not. Why?

X	3			
	-1	2		
		0	4	
			5	3
				1

A nice reference which can be purchased in the U.S. is Puzzle Tables by Thomas C. O'Brien (published by Cuisenaire). This book contains many number problems with computational skills which can be reproduced to be used with the students.

The Implementation of Curriculum Change in School Science in England and Wales

Mary Waring

No crystal ball is needed to show that the history of planned curriculum change during the last 20 years has indicated just how formidable an undertaking it really is (Becher and Maclure 1978, Stenhouse 1975, for a recent study of American experience see Stake and Easley 1978.) Few of the many exciting proposals that have formed the bases for curriculum development (and, as was then hoped, for continuing widespread change) have realized change that is describable as anything other than 'considerably less grand' than was anticipated. In part, this is because centrally-developed projects tend to be overtaken by events, but it is also because curriculum projects were, in the past, too readily thought of as embodying innovation, which could then simply be transferred to the classroom. As Hamilton (1975) has pointed out, the locus of innovation is, and can only be, the classroom. It may be that the expectations of some projects were simply too high, but there is also evidence that they were providing solutions to problems that teachers did not have, or which were not their main problems (McKinley and Westbury 1975, Harlen 1977).

The work reviewed in this article suggests a need for curriculum innovation, development and implementation to be located within a new conception of in-service work, in which the earlier image of an informed elite bearing gifts, or 'reorientating' teachers in 'more appropriate' directions, is replaced by a situation in which teachers themselves work on their own methods and materials with the help of colleagues and of outside researchers, drawing, where relevant, upon centrally-produced resources (because of the high cost and the range of expertise needed to produce up-to-date resources [Hartley 1976]).

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2. Hamilton, David 1975, Handling innovation in the classroom: two Scottish examples. In *Case Studies in Curriculum Change: Great Britain and the United States* edited by W.A. Reid and D.F. Walker (Routledge and Kegan Paul: London) p. 197.

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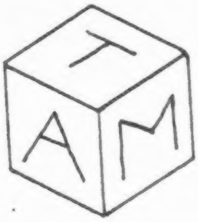
This excerpt is taken from Mary Waring, "The Implementation of Curriculum Change in School Science in England and Wales". European Journal of Science Education, Vol. 1, No. 3, pp.269-70.

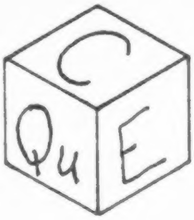
Vocabulary Development Game

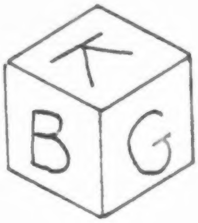
Gracia Myers and Katheryn Midyett

Here's a slight variation of one of Tom's vocabulary games that can be found in Solve It! (Set 4 -- a publication of Educational Teaching Aids.)

Put the letters of the alphabet on the faces of six cubes -- using Qu instead of Q. Use the A five times; E, I, O are used three times and U is used only once by itself (and again with the Q).







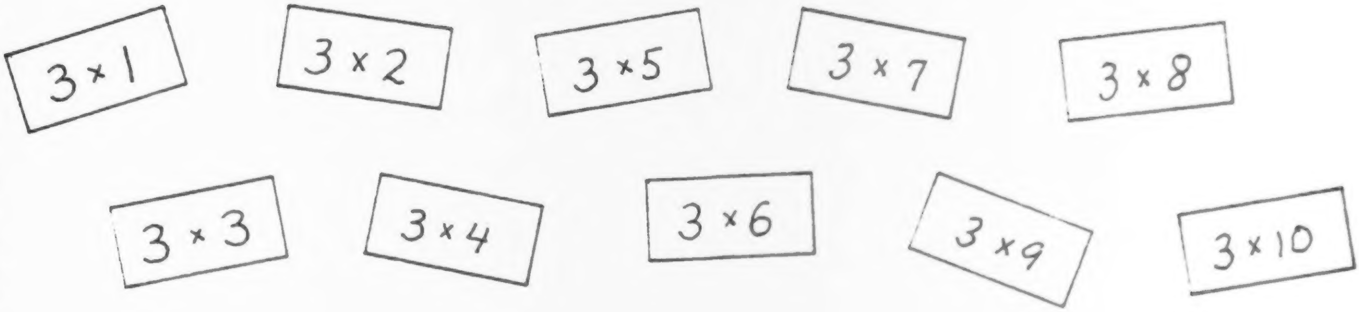
The game can be played with 2-4 players.

The first player throws one die. He earns a point if he can say a word that contains that letter. (If you want to practice spelling then he must spell the word.) The first player continues with the second, third, fourth, etc. cubes. His score amounts to however many cubes he used for his last word. Or -- if you want some addition practice thrown in, he can score one point for the first word, two points for the second and so forth. If at any time he is unable to make a word he loses his points for that round. He may choose to stop at any time and keep his points. If he decides to stop after the third die he has three points (or six, depending on your rule.)

Play continues through five rounds -- or a set number can be the goal.

Mailings

Bob Jeffery


3 × 1
3 × 2
3 × 5
3 × 7
3 × 8
3 × 3
3 × 4
3 × 6
3 × 9
3 × 10

These cards have the answers on the back.

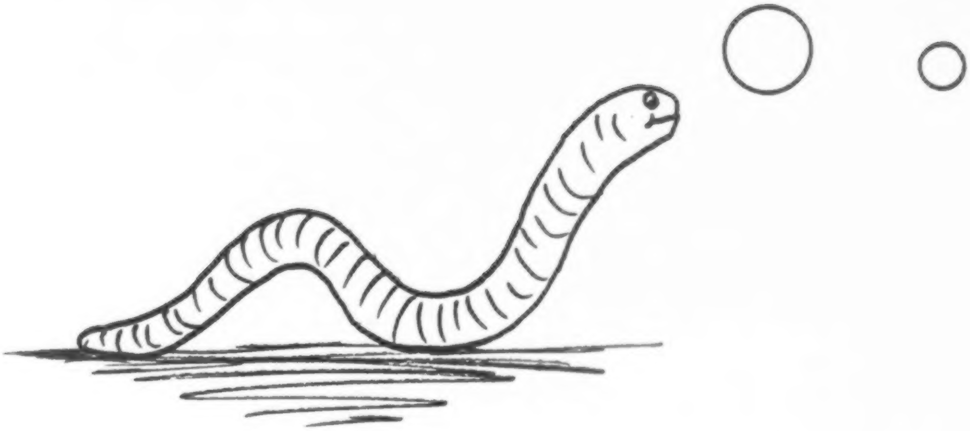
Mail some cards to a friend who wants to know 3 x 14 = _________.

Mail some of the remaining cards to a friend who wants to know 3 x 17 = ________.

Can you help someone who wants to know 3 x 21 = ________?

On Conservation

William Breden



Does a flexible worm change his surface area/volume in crawling into the smaller hole?

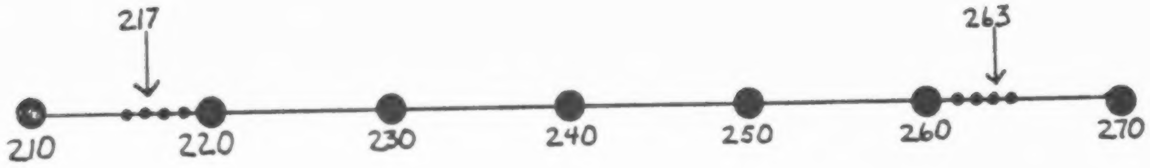
Tickets

Ed de Moor

Today the movie theater sold tickets beginning with number 217 and ending with number 463.

How many tickets did he sell?

Could the number line help you?


217
263
210
220
230
240
250
260
270

Fourth Law of Thermodynamics--
If the probability of success
is not one, then it is damn
near zero.

A Grid Problem

Thomas C. O'Brien

Ed de Moor presented some lovely problems like this:

How many solutions using only integers?

X	3		7	
		8		12
	9			
4				
	15			

X	5			
6		18		
				24
	30		60	

Then came this one:

Design a multiplication table. Try to leave out as many numbers as possible. In general, what is the smallest amount of numbers you need to start with to find a complete and unique solution?

X				

A nice problem. Now how about this? Same rules.

$\text{left}^2 + \text{top}$	4	6		
3	13		20	
8				
				30
		106		

Puzzle Square

Pat Dyer

Using 10 x 10 squared paper, fill in squares with numerals (in order) 1-100, leaving several squares blank on each line.

1	2		4		6	7	8		
	12			15			18	19	
		23	24		26				30
31				35		37	38		40
	42		44					49	
		53		55		57			60
61	62		64			67	68		
	72			75				79	
		83			86		88		90
91			94			97		99	

Mount on construction paper. Cut apart as a puzzle and let children reconstruct.

Extensions:

1. Make puzzle squares filling in only multiples of 2-9 (skip counting with one number per puzzle). Mix up 2 or 3 puzzles together for a challenge. (See diagram).
2. Make puzzle squares of subtraction and multiplication combinations (10 x 10 squares).

Ten's Bingo

Mary Steffen

Ten's Bingo can be played for several purposes by varying the number called and/or the selection of numbers on the cards. The game is designed for addition. What other uses can you find?

Materials:

1. Bingo markers - chips, corn, etc.
2. Bingo-like cards of 16 squares containing several 10's and other single digit numbers.
3. Numbers to be called. These can come from the caller's head, from a prepared list, from the sum of rolled dice, etc.

How to play:

1. Select a caller.
2. Each player gets ten markers and a card.
3. The caller presents a number. The players mark the called number on their cards by covering as many or as few numbers as they wish in order to total the called number.
4. Bingo is called when a player covers all his squares in a row, a column or a diagonal.

Here is a sample Ten's Bingo card.

3	10	2	6
7	5	1	10
2	9	10	8
4	10	1	4

Backwards Grab

Thomas C. O'Brien

Early in the course Bob Jeffrey introduced the game "Grab." Each of a number of players reaches into a bin and grabs a handful of contents. (In this case we played with Pepperidge Farm Goldfish crackers; one could use peanuts or pebbles or pencils.)

If the group of things can be separated into groups of two with none left over, a player gets two points.

If the group can be separated into groups of three with no remainder, three points. Groups of four, four points, and groups of five get five points.

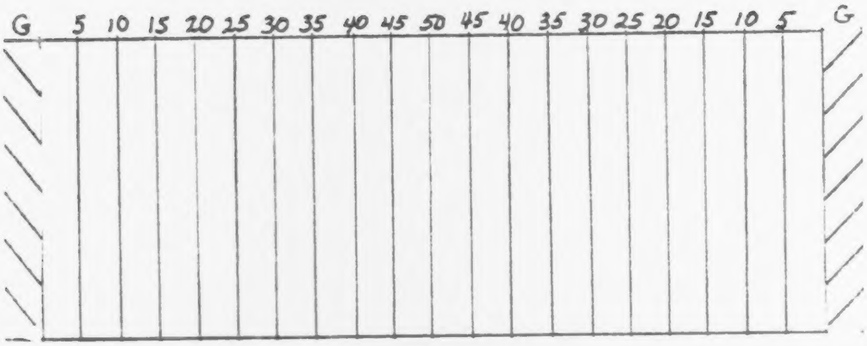
That's the lovely game of Grab. Do you see any extensions or elaborations?

Backwards Grab is this: Choose a number from 1 to 15. If that number is the number of points scored by a Grab player, how many things (pebbles, etc.) did the player have? For example, suppose a Grab player scores 6 points. Can you tell how many items he/she had?

> Chamberlain's Laws--(1) The big guys always win, (2) Everything tastes more or less like chicken.

Fraction Football

William Breden



Materials: two players and two dice

Each player rolls his/her dice and makes a proper fraction. The person with the largest fraction finds the difference between the players' fractions and moves the ball toward the opponent's goal from the fifty yard line. The number of moves one makes is determined by the numerator of the difference.

A player wins the game when he/she crosses the goal line.

A penalty is initiated when a player gives the wrong response for the difference and is caught by the opponent. The ball is moved back the correct difference.

Adjust The Kahoten Valve

Helen Miller

Do the following: "Pull out the kahoten valve attached to the whatjimacallit; release the thingamajig on the top; this will force the dofloppy to accelerate properly."

If you are having trouble following these directions, think about children who must produce a diagram to show the participle, the prepositional phrase and the gerund.

How much easier it would be to accomplish such tasks if teachers would relate an unfamiliar task to something with which the child is familiar. Textbook companies also expect children to understand words referring to things the child has never heard of, much less seen.

In the upper grades, children seem to learn the various parts of speech much faster if they have had an opportunity to write stories, essays, and themes pertaining to the things with which they are familiar. To teach the parts of speech before a child is able to personally become knowledgeable about, and comfortable with language through use of language, seems a bit like putting the cart before the horse.

In kindergarten, I have found that children learn a new concept much more easily _after_ we have worked with concrete objects. If a page in the Math book suggests that the child find all the buttons that are alike, we get out the box of buttons and find all the buttons that are alike. If the problem requires the children to mark the first, second, third, etc. car in the row, the children work with toy cars lined up. They then select the first, second, third car.

There are very few problems that we cannot do in this manner. With a little imagination, everything can be solved in a very tangible, concrete manner, before the children are introduced to the symbolism in a text book.

Especially at the preoperational stage of development, the child is very much influenced by what he perceives. If he is able to work out the problem using concrete materials he is much more likely to be successful in performing symbolistic tasks in a workbook.

I feel it is vital for every teacher to provide the opportunity for the children to solve problems using concrete items. It takes very little extra time, effort, or materials. The result is a much higher level of comprehension and achievement. Isn't that, after all, what we are in business for?

* *

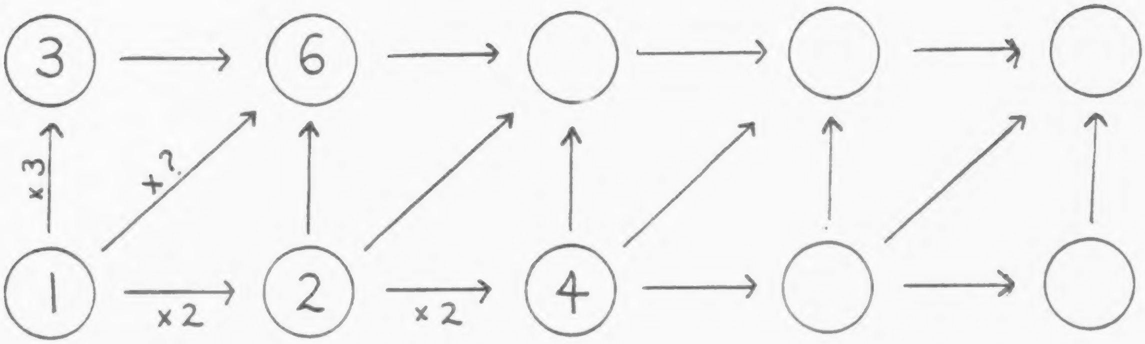
Excerpt

"Back to basics" is another wrong perspective. The right way should be forward to basics. A grandfather clock is not basic, nor is grandfather's arithmetic. Old-time arithmetic will never return; old-time teaching of arithmetic will never be revived.

--from Hans Freudenthal, "New Math or New Education?", Prospects, IX, March 1979.

de Moor Is Bent

Bob Jeffery



* *

Don't Fall Off The Number Line

(With compliments to Bob Jeffery)

A number line goes from 0 to 100 inclusive. A person chooses a number from 1 to 9 and, starting from 0, jumps that number of steps until he/she can go no further without falling off.

Then the person chooses a different number and jumps that many steps back toward 0.

If you know where the second journey ended, what can you say about the two numbers chosen?

Scatterers

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Cahokia, Illinois

William Breden
Jerseyville School District #100
Jerseyville, Illinois

Shirley Casey
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Southern Illinois University
Edwardsville, Illinois

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Mary Waring
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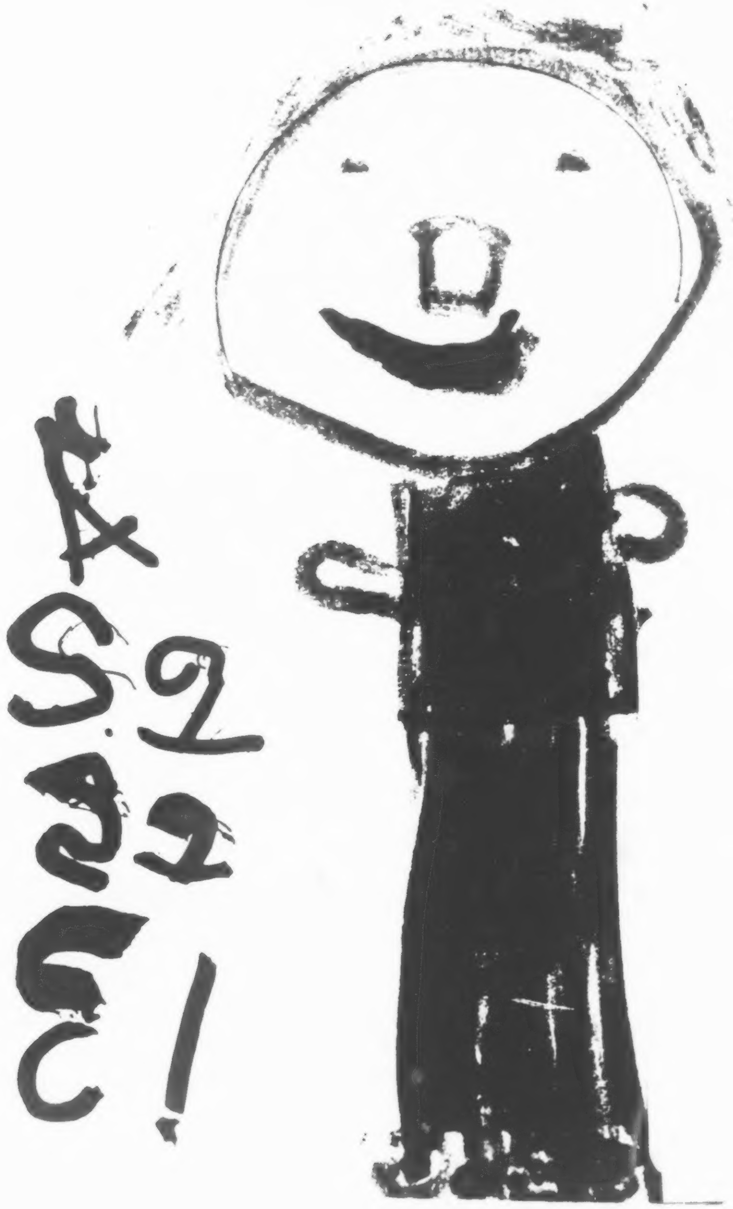
University of London, UK

He counted wrong. He's a person and he doesn't Know how to count right. His sister Knows how to count and his sister is going to teach him how to count.



Jamie Whitford

SEEDBED

SEEDBED

Number 8

March, 1981

Teachers' Center Project
Southern Illinois University
at Edwardsville

INTRODUCTION TO SEEDBED

It is with pleasure and pride that we publish the eighth issue of SEEDBED. As usual, SEEDBED is for doing, not merely for reading. Try things out. Bend them, as Bob Jeffery recommended. And share your inventions, findings and successes.

I must write about an issue that has been haunting me. In the past month or so there appeared in the local newspapers an article on a major public service agency--something like a health insurance agency, but I won't go into specifics--at which, newspaper reporters discovered, giant gobs of incoming mail (requests for reimbursement, inquiries) were chucked "behind the fridge." The very purpose of the agency was "inoperative" when newspaper reporters arrived.

"But," I thought, when I read the newspaper article, "I'll bet that the agency went on with its routine affairs." I'm certain that meetings were held, minutes were kept, press releases were issued and all the rest. The "dress" of the agency went undisturbed.

My point is that we in education can easily misinterpret "dress" for substance. We hold our meetings, keep our minutes, send out press releases and play grantsmanship and numbers games. (I recently saw a five-year-old's artwork graded with an 87.) Perhaps we should keep in mind the fact--IT IS A FACT--that school education is for children. That, not "dress", is the name of the game.

SEEDBED 8 is ultimately for children. That's our intent. But it is up to you to try out, extend, bend, revise, question, and adapt (not adopt) what's here if our intent is to succeed.

Thomas C. O'Brien

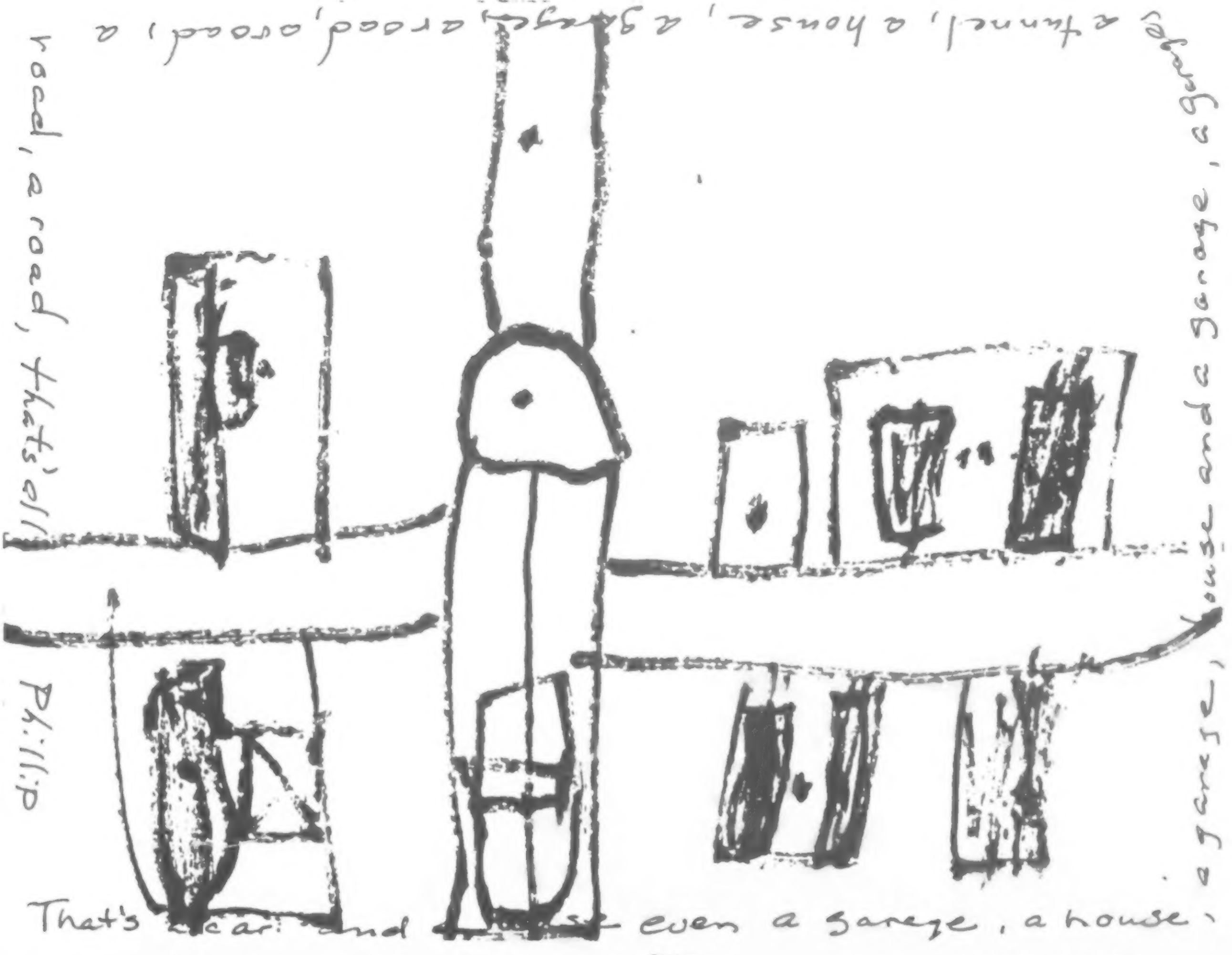
26 February 1981
University City, MO

ABOUT THE COVER

The artwork on the cover of SEEDBED 8 was done by Jamie Whitford, a kindergarten student at Logan School in Granite City. His teacher, Helen Miller, had asked her students to make a picture and then to dictate a story about the picture which she would write around the outside of it. Her rule was that the story had to be long enough to go all the way around the picture.

Other examples from Helen's students appear throughout SEEDBED 8.

We regret that we were not able to reproduce the children's work in color.


That's a car and [illegible] even a garage, a house,
a garage, a house and a garage, a garage,
a tunnel, a house, a garage, a road, a road, a
road, a road, that's all
Phillip

Phillip Martin

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Diary of A Teachers' Center Meeting--Part 1

Thomas C. O'Brien

It was the first meeting of a new Teachers's Center session. Fourteen or fifteen people - some old, some returning - showed up. I had planned a session on inference and children's inference abilities. Inference had occupied the two weeks just passed - my son and I had spent Christmas vacation putting inference games onto interactive video computer discs - and it was an issue burning to be shared.

To acquaint folks with the arena for the inference games I had devised and to see what just might happen in general, I posed the following question: How could you use this grid with children?

A	B	C	D	E
F	G	H	I	J
K	L	M	N	O
P	Q	R	S	T
U	V	W	X	Y

Well, it was off to the races. What could you do with the grid? Here are a few things that were suggested and tried by the group:

1. Start with A and work your way through the alphabet with initial letters: Apron, Bicycle, Computer, Dog, etc.
2. Choose a particular category and work your way through the alphabet. For example, fruits: Apple, Banana, Cherry, Dewberries, etc. Automobiles: Auburn, Buick, Cadillac, etc. Cities: Albany, Buffalo, Chi-

cago, etc. Foreign cities: Athens, etc.

3. Start with A and work your way through the alphabet naming things which belong to as many categories as possible. For example, April is both a month and a girl's name.
4. Write a paragraph using the initial letters in order: All boys can do every flag (as in a drawing lesson). Girls...
5. Write a paragraph taking letters in order, vertically from the grid.
6. Write a paragraph using every letter from the grid at least once as an initial letter.
7. Cut the grid into scrabble-like pieces. Select pieces at random. Make words from the tiles. Use up as much of the grid as possible.
8. Cut the grid into scrabble-like pieces. Select pieces at random. Make as many words as possible. For example: P. (no word), B. (no word), M. (no word), A. (PAM, BAM, MAP).

To read our list, frozen in print as it is, is like reading a laundry list. Better to try the activities in groups of three or four to get the feel of things.

The activity session was by no means finished. We agreed to try out some of the games with children to see what we could find out. Some reports are given in Part 2.

Before we moved on to children, though, here are some observations on the activities as played by the group:

1. The games caused us to think. (What is thinking, I asked.)
2. There was no right or wrong answer. Rather, there were answers and better answers, the "goodness" of an answer determined not by an answer key but by coherence and complexity.
3. There was a great deal of freedom - within the constraints of the rules of the game - for different answers. In fact, to get two answers which

were the same would be quite a surprise.

4. There was a great deal of collaborative give and take. One learned a lot from the next guy.
5. There was a great deal of backing and filling. We started out and reached a block, scrapped our start and began anew (having learned something from the first go).
6. In fact, much of the work amounted to successive approximations.

The issue is by no means finished. More, as the result of the second meeting, in Part 2.

Postscript: One of a number of interesting asides came up when one of the participants drew a B, then a P, in game 8. Instantly the comment came: no word possible. Aha, I thought, there's a feel for language. In English two.letter words are possible, but nothing with BP. In some languages, perhaps, BP might be a word (though I doubt it). To know instantly that BP is not a possible English word is evidence that a person knows the language.

This gives rise to the question, what does it mean that one knows something? What does it mean to say that you know New York or St. Louis, for example? Give that some thought? Then another, no less trivial question: what do you look for as evidence that someone - a child in your class - knows something???

Diary of A Teachers' Center Meeting--Part 2

Well, the issue did go somewhere! Here are some of the many follow-up ideas, activities and observations that came in.

1. There are at least four distinct approaches to the task where all the letters are to be used in words. One is to make distinct words. Can you find a way to use all the letters?

S	T	O	R	Y

D	I	G

H	E	N

The second is to allow for multiplication of words, as in Scrabble:

	P				
M	A	P	L	E	
	T	O			
		D	U	M	B

The third allows for words reading up, down, forwards or backwards. All the letters belong to a word, though sometimes you have to look hard.

		D
		O
S		L
P	I	E
A	N	
R		
K		

And the fourth permits embedded words. The array below has three words. (Thank you, Pat Holtgrave.) Can you find them?

S	P	E	D	I	T	A	L	Y

2. Theresa Grace suggests a game of Bingo. The letters are cut out and put into a container. One by one letters are drawn out and read to the class. Once a letter has been drawn, it may be used without limit. When someone makes a word using the letters drawn, he/she calls "Bingo" and receives one point. Fifteen points wins the game.
3. From Vicky Sargent: "I tried out the activity [making words using A-Z] with my sixth-grade daughter. She cut out the letters and used them as Scrabble tiles. At first she tried making one word at a time with no connection between words. She then (spontaneously) used a letter (it was a vowel) in more than one way, but she looked at me to question whether that was acceptable. I simply restated the rules: Use all the letters in words. She eventually made words going every which way - frontwards, backwards, up, down, overlapping and she succeeded, but with each new addition to her tactics she needed approval from me. To watch her was most interesting. She would often get stumped and lay down a letter just to see how it looked in combination with others. Often it seemed as though a light bulb were lighting up: her thinking had started her on a new path."
4. More from Vicki Sargent: "Why not use the materials that are around us? When new telephone books are delivered, why not turn the old ones over to children? Using the A-Y grid, children could build a list of phone numbers of friends, (Armstrong, Baker, etc.), of places of interest, of stores or everyday places of importance, (animal hospital, beauty shop, etc.)

5. For initial consonants, how about using the things around us, says Pat Holtgrave? "I asked a couple of first-graders to help with an alternative searching game. They were to look at every day objects (a roll-around book cart, a fellow student, for example). Once a letter was used, it was scratched out on the grid. The task was to use all the letters. In looking at the bookshelf, they x'ed letters for Books, Scissors, Paper. Interesting, they seemed to zero in on things, rather than attributes. Nothing like colors, for example, or relationships.

6. An interesting observation from Pat Holtgrave: "Grade 1 children went about the task [finding objects in the classroom beginning with A, B, C, etc.] in a way which surprised me. They fixedly started with the letter, i.e. B. 'Let's see. Where's a B thing,' but they didn't do any widespread scanning which would conquer much of the task pretty quickly, i.e., 'Let's see what letters we can knock off. There's a Book, there's a Pencil, there's the Floor, there's the Ceiling, etc.' Moreover, they tended to go after the letters in the order presented."

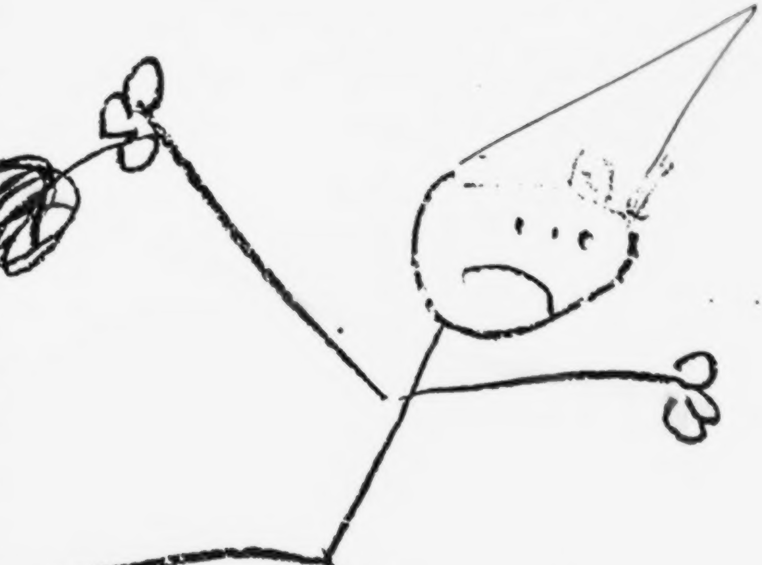
   "In another game I called out letters for children to x out letters on the grid I provided them. What I intended was that the x'ed out boxes would make a figure - a big E, for example or a house. They did not recognize the figure they had made - it was a big E - until I traced it onto a clean grid sheet with no letters. Then the lights came on. 'It's a big E,' they said. I am going to try this again, but this time I am going to ask them to black out the letters instead of x'ing them out.

7. From Lori Buenger: "Here are some ideas that could be used with young children. I am hoping to have the chance to try them out. 1) Make an ABC strip to be given to each child in class. Use it in some of

the ways that one uses a number line. For example, one could play the game, 'I am thinking of a letter.' One child writes down a secret letter and the other guesses what the Secret Letter might be. With each guess, the response is given, 'No, it's after C in the alphabet' or 'No, it's before M in the alphabet' or 'Yes, you've got it.'

"Also, why not cut up the letters, place magnetic tape on the overside, and have kids label everyday objects with the letters: C goes on Chair, E on Eraser, and so forth."

He wanted to catch a bird and then he went
to the 2nd to get a bird because
he wanted a blue bird and now he's not
sad. And now he is going home to
play with it. Samantha



Samantha Hoffman

An Overview of the East St. Louis Seminar for Teachers Conducted by James R. MacLean

Linda D. Tholl and Judy Chapman

"Evaluation is solely the responsibility of the teacher," said Jim MacLean. "Teachers have been found to be the best in providing evaluations on achievement."

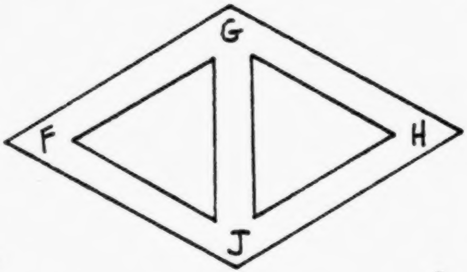
He stressed the need for using innovative instruments to evaluate achievement, rather than tests. "We are developing a generation of test takers!" Assessment is the process of gathering information and it should include things children produce. Evaluation can only be done by a human. When teachers are responsible for developing instruments of assessment, there is a feeling of ownership.

The important point in assessing children is that we know if they are really grasping concepts. So often we as teachers promote memorizing formulas to plug in numbers with little or no thinking. We should ask open questions and if the questions are too open, we can always ask additional questions to close it.

Here is a problem posed by Jim MacLean.

One route from F to H is FJH.

Find three other routes from F to H.



The key is to give kids chances to make mistakes. Jim MacLean is trying to legitimize child watching and encourage it. Information gathering is necessary for assessment and evaluation.

An investigation for you:

Ask your children which of the fractions is greatest. You may be surprised at their answers.

$$1/3 \times 1/2 = 1/6^*$$

Demonstrate respect for children. Their time is as precious to them as our time is to us. Children must see some purpose in what they are doing.

"As you value my work, teacher, so you value me." Jim MacLean.

---

*MacLean quizzed kids and adults on this one. Many said that 1/6 is the largest because "multiplication makes things bigger." They may have known a recipe for multiplication of fractions but did they understand what they were doing?

Air, Land, or Sea Categories

Carolyn Farmer

This category game may be played with small groups or pairs. One person selects a category, either air, land, or sea, and the next person must name an animal that lives there. If a correct animal is selected before the count of five then that person in turn selects a category for the next person. An animal may be used only once. One of the group may be chosen to be score keeper and judge.

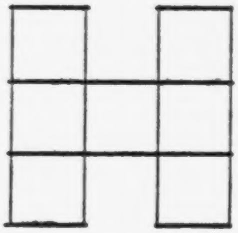
This game is excerpted from Language Arts Activities for the Classroom by Tiedt and Tiedt.

Two Simple Problems

A.I. Weinzweig

Here is a problem that I am pleased to share with my Teachers' Center friends. I think very highly of you, enjoy my visits with you, and hope that what follows is productive for you.

The first problem is this:
Using the numbers 1 to 7 once and only once, fill in the boxes at the right so that the sums on all three branches are equal. How many ways can this be done?



The second problem, perhaps more fruitful, is this:
Pose the problem for some children (or adults). What can you find out about the way the problem solvers solve the problem?

Problem Solving: A Brain Talks To Itself

Mary Steffen

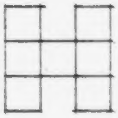
This article is a result of a recent visit by Professor A.I. Weinzweig of the University of Illinois, Chicago Circle, to the River Bluffs Teachers' Center.

Izzie's been and gone, leaving behind a lovely problem. He challenged me to record my brain activity in finding the solution. The task sounded simple. Just record everything my brain said to itself. Unfortunately my brain speaks to itself in very little English.

Translating my brain activity into common English was an exercise in elaboration. The amount of thinking going on was inversely proportional to the number of words employed. Most of the real thinking is done in images, balances, insights involving relationships without words. When English happened, it was between thoughts or to confirm and deny theories. Words like 'yes', 'no', 'hum', 'try ...' and 'what if ...' are not very enlightening when used alone.

On to my translation of my solution. Here's Izzie's problem:

Use the digits 1-7 in an H configuration so that each row adds up to the same number.



My first thought centered around the range of choices I had for the three digit sums. The smallest, I thought must be 7 + 1 + 2 = 10. The largest must be 5 + 6 + 7 = 18.

Reasoning: 7 had to be somewhere, and added to two other numbers, the smallest possible two choices were 1 + 2. Thus no row could total less than 10.

Would 10 work? How many ways to make 10? Not long ago I had used rods to find out how many ways to make 10 using 1-10 size rods. That, I thought, was 40. My number of combinations was smaller than 40 and thus manageable. I could use a tree diagram to find them all. I didn't like that. Too organized. Thinking is easier. Wonder if I can do it in my head?

I thought about adding the smallest and largest numbers in a consecutive or evenly spaced series. The totals each time were the same, i.e. 1, 2, 3, 4, 5, could have 1 + 5 = 2 + 4, 3 being the middle. Maybe if I used that idea and swapped two numbers for the vertical lines and put the middle number in the cross bar I could total ten. Four was pivotal--got that on my fingers! That leaves 6 to split in two parts to complete the cross bar

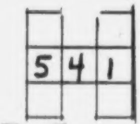
3 4 3? No. Can't use 3 twice.

4 4 2? Nope, same problem.

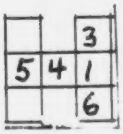
5 4 1? That works.

_ 4 _? 6 and 7 are too big. Any left? Nope.

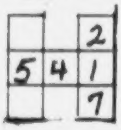
Now put what's left on the corners using the "each end of a series" idea.



5's on the left--put 6 on the right so 3



What's left? 7 + 2 — oops! so



6 won't work with 5. Those big numbers are a pain. With 10 total 4 won't

go in the middle. SLOW progress.

Let's try 4 again and total 12.

5 4 3

Put 7 on the small side so 2

		2
5	4	3
		7

What's left? 1 and 6

1		2
5	4	3
6		7

It works? I have one! That was easy! But there is more! Hum! But there is an easier way too. What totals do I have to try? Add the digits up. 28. Now add the "used twice" digit to 28. Smallest possible total is 30. Divided by 3 that's 10. 10 is the smallest possible total. Confirms other theory. Must be right. Announced that theory and in explaining discovered I had used only one number twice. Needed to use two numbers twice. Quit thinking. That avenue was as difficult to try as using trees.

NEXT DAY:

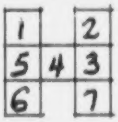
I'm gonna solve that problem! That add them all up idea has promise, but do it right this time.

Start with 28. Smallest possible two numbers to use twice? 1 + 2 total 3. Hum!

(At this point a flood occurred. The order of events is lost. Actually, I'm not sure the events that occurred did occur in an order.)

Find numbers divisible by 3 between 31 and 41. Find difference between 28 and each of the numbers between 31 and 41 because that number is the sum of the spaces at the ends of the cross bar. The middle of the cross bar will be determined and the other four left over numbers will fit in the corners. Whatever is the answer to the "divide by 3" will be the individual row totals.

Check it out with the one you already have that works.

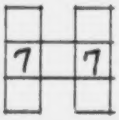


Sum = 36. Divide by 3. 12 is the sum on each bar. Difference between 28 and 36? 8. Sum of the cross bar edges 5 + 3 = 8. Wow!

What other row totals do I need to consider?

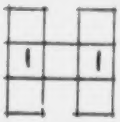
30	divided by 3	10
31	" " "	nope
32	" " "	nope
33	" " "	11
34	" " "	nope
35	" " "	nope
36	" " "	12
37	" " "	nope
38	" " "	nope
39	" " "	13
40	" " "	nope
41	" " "	nope

41 wouldn't work anyway - don't have enough numbers left over for the corners. Try 42 just to confirm. 42 - 28 = 14



can't use two sevens.

Try 30 new way: 28 + 2 = 30

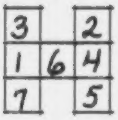


can't use two ones.

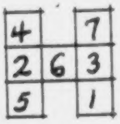
Have 12 already. Try 11. 33 - 28 = 5. Possible ways: 1 + 4 = 5, 2 + 3 = 5.

Try each: 1 _6_ 4

What's left? 2, 3, 5, 7



Works. Other possibilities?



Works.

Now try 13.

39 - 28 = 11   6 + 5 = 11
                 7 + 4 = 11

6 2 5 left over 1, 3, 4, 7

3		7
6	2	5
4		1

Works!

7 2 4 left over 1, 3, 5, 6

5		6
7	2	4
1		3

Works.

Since there are two each for 11 and 13. Let's try 12 again. Maybe it has two as well. 36 - 28 = 8 so:

5 + 3
4 + 4
6 + 2
7 + 1

5 4 3 left: 1, 2, 6, 7

		4
5	4	3
		5

nope

6		7
5	4	3
1		2

nope

7		
5	4	3

nope

		7
5	4	3

done that one -- Doesn't work

Try 6 + 2   6 4 2 left 1, 3, 5, 7

1		3
6	4	2
5		7

works!

Try 7 + 1   7 4 1 left 2, 3, 5, 6

2		5
7	4	1
3		6

works. Hey! is this a rotation? No.

Two each for 11, 12 13   four possible solutions:

I'm tired! If I wasn't I'd try to see if there was some sort of relationship involving the middle numbers.

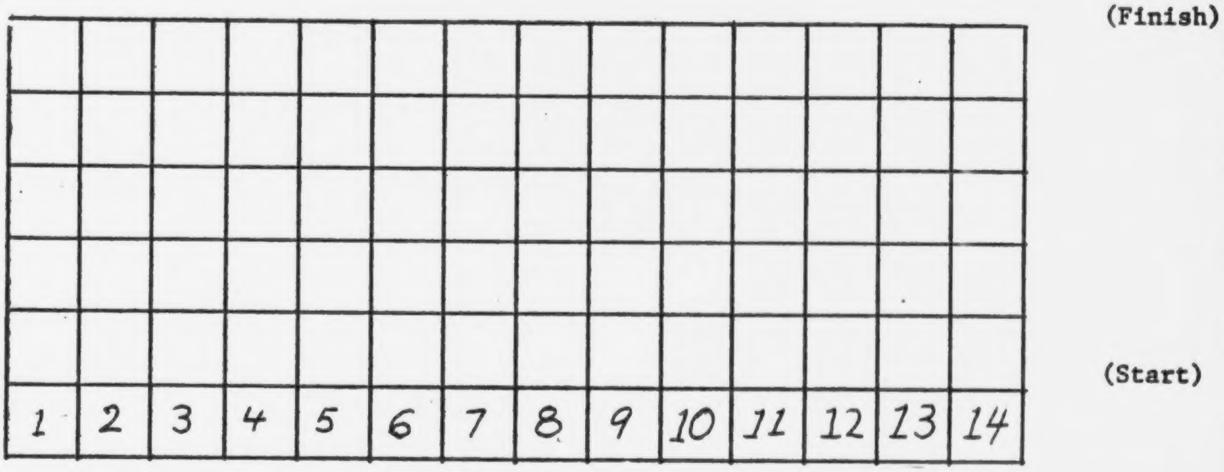
Next day again:

There is a relationship between the middle numbers.

Race With Two Dice

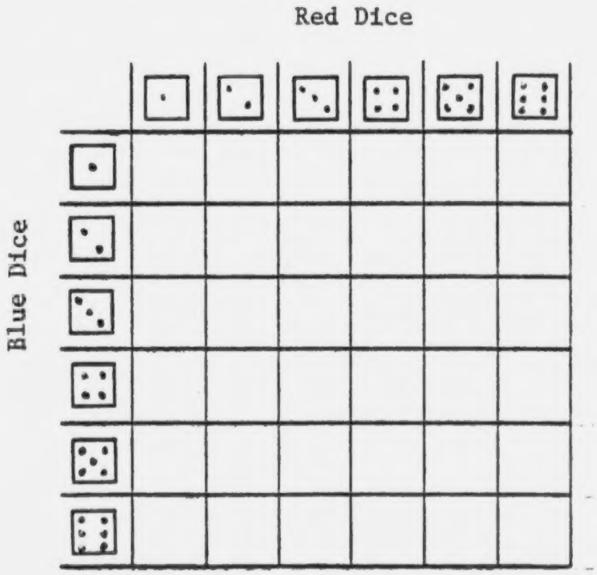
Tamas Varga

Kids choose among fourteen number cards, numbered 1-14. Two other kids who have no numbers throw two dice, add the dots and shout the result. He who has that number can make one step forward. At the beginning of the game the children are lined up behind a line. Five parallel lines show where they may step. The one who passes the front line wins.



The children may continue the game after that, for instance until two others reach the front line. Then the first gets a gold medal, the second a silver, and the third a bronze. After that they can change thier numbers. They will probably want to choose the numbers winning medals. To avoid dispute more than one can choose the same number or numbers. None of them is likely to choose 1, 13, or 14. They may even realize that these numbers have no chance for allowing even one step. Numbers li[illegible] 11, or 12 may still appeal to them for a while, but after a certain number of games they increasingly favor the numbers in the middle such as 5, 6, 7, 8 or 9. Let them discuss this. Depending on their age they may simply accept as a fact that the numbers in the middle come up more frequently than those on the two extremes, or else they may try to find a reason why.

A further game may enhance such reasoning. This consists of throwing the two dice again, this time without letting the kids choose among the numbers, but placing the number cards on a square grid. In this game the two dice should be visibly different. One of them may be blue, the other red. The square grid looks like this:



When the two dice are thrown the kids shout the two numbers, telling which number is on the blue and which is on the red, and then their sum. For instance blue 2, red 5, 2+5=7. Then someone puts a card with the number 7 in the space which is in the row of the blue 2 and the column of the red 5. So they go on placing 5 to 8 cards on the spaces where they belong. Then they may start to discuss questions like, "Where could we put another 7?" "Another 5?" "Where will be the 4's, the 8's?" They continue filling the grid with the number cards without actually throwing the dice. They find that there are six 7's, but only five 6's, and five 8's, four 5's and also four 9's and so on up to just one 2 and 12. The teacher does not tell them anything about this activity being related to the previous two dice races, but there will probably be kids who see the connection between the two activities. This will more likely be the case if after the second game the teacher goes back to the first game asks, "Why are the numbers in the middle better to choose than those at the two ends?" If they still do not see the connection then it is better to let them think about it rather than give them the answer.

It's a house. And it has a lot of people in it
and smoke going around it and
the house has a lot of windows and doors and
it actually gets some gross. Amanda

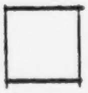
Amanda Dawson

"Square Off"

Marcella DiPaolo

Using different colored construction paper, cut into 3" by 3" squares. Each child is given a pair of scissors and 12 squares. How many different shapes can you make from the squares? Each square can be used only once, and if desired, cut only once.

Ex.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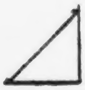
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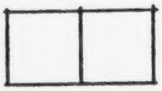
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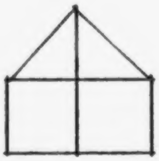
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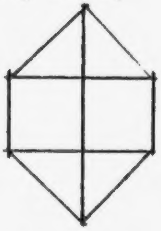
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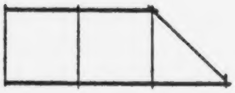

polygon

Change for a Dollar

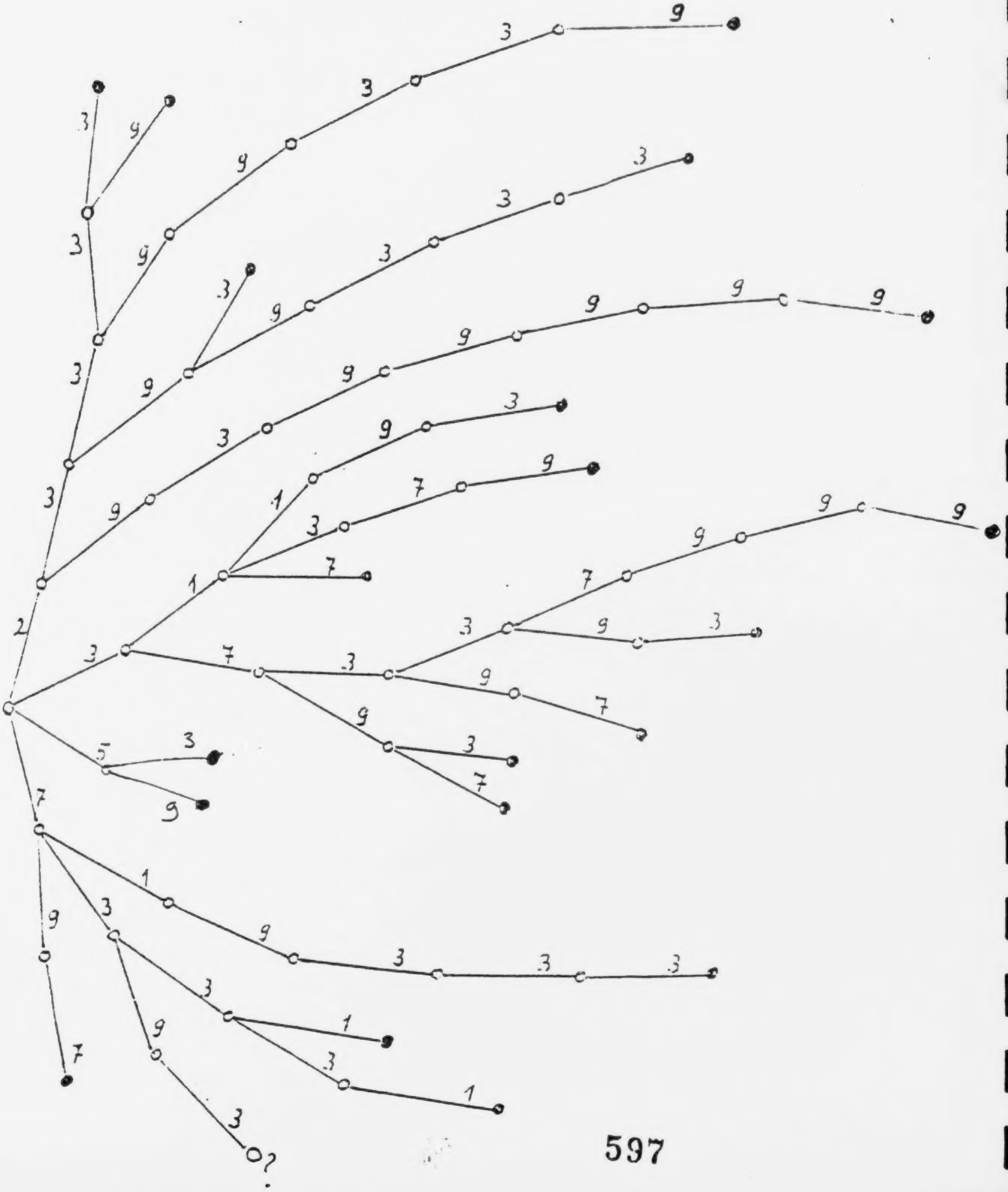
Terry Lyday and Kathy Lowry

Problem: There are many ways in which you could make change for a dollar. If given no more than four of any coin, in how many different ways could you make change?

There are eight possible ways of making change under these prescribed conditions. Can you name them?

Right-truncatable Prime Numbers

Tamas Varga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?

Look at the list of two digit prime numbers: 11, 13, 17, 19, 23, 29, 31, 37, 41, 43, 47, 53, 59, 61, 67, 71, 73, 79, 83, 89, 97. Truncate them (omit their last digit). What remains can be a prime (2, 3, 5 or 7); let us call these two digit numbers truncatable primes. Such are 23, 29, 31, ..., 79. You can similarly define three or more digit truncatable primes. Find some of them.

Using a programmable calculator or a computer you may want to tackle a more demanding project: deciding whether there is a finite number of truncatable primes or if there are infinitely many. (If the first is the case, find all of them.)

JAmie Wells
It's a racingcar and it's got fast
wheels and it has the number 100
and it's got a motor in it.
100

In 1492 ....

Helen Miller

Every year for Columbus' anniversary I give my kindergarten children a paper plate with "Columbus" and "1492" written on the edge. They are then given three triangles that represent ships and three triangles that represent sails and are told to glue them in a certain place on the plate and to draw blue water beneath the ships. In this way we have "created" something to remind them of Columbus, something for parents to extol as "cute" and we have had an exercise in following directions.

This year, I thought it was time for the children to create their own pictures.

We talked about Columbus. We looked at many pictures of Columbus and many pictures of his ships. We also had several mimeographed sheets depicting Columbus' ships with sails. I then proceeded as usual to give them paper plates with "Columbus" and "1492" printed at the top and triangles.

This time my directions were: "Make Columbus' three ships, each with one sail."

You would not believe the problems and perplexed looks which resulted.

Finally, one brave little soul said, "What is a sail?"

Not one of the children knew what I had meant by a sail. They all thought the sails were flags!

I proceeded to get out a pan of water and a piece of styrofoam, a piece of paper for a sail, and a toothpick for a mast. After a few sinkings we finally got the boat to float.

"Is the boat moving by itself?"

"Blow gently on the sail and see what happens."

When everyone had had a turn we could return to our project.

There were still children who could not make the connection between the triangle sail and the sail on the boat, but several created marvelous pictures - one was even three dimensional.

I wondered after all the children left: Have I been merely making kids more perplexed all these years? This year a few parents looked a bit perplexed, but the children did not. They were very anxious to show their ships with sails!

More and Less

Helen Miller

Two children play "More and Less". It takes a number line from 0 to 10 and one die. One child begins at the 0 and the other at 10.

The child at 0 rolls his die and counts the dots. He moves that many places up the number line.

The other child begins at 10 and rolls the die. He counts the dots and moves down from 10 on the number line.

Each child takes a turn rolling the die and moving up if he is on 0 or down if he is on 10.

The children trade spots - "0" child goes to "10", and "10" child goes to "0" to start. The game begins again.

As the children gain a larger concept of numbers, the number line is lengthened to 24 and two dice are used. They proceed from opposite ends as in the original game.

Odd and Even Phrases

Carol Sulc

Take the odd numbers and put the letters under them in order to make up a phrase.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
T	L	H	I	E	F	Q	E	U	I	A	S	L	B	I	E
17	18	19	20	21	22	23	24	25	26	27	28	29	30		
T	A	Y	U	O	T	F	I	T	F	H	U	E	L		
31	32	33	34	35	36	37	38	39	40	41	42	43	44		
I	W	M	H	A	E	G	N	I	O	N	N	A	E		
45	46	47	48	49	50	51	52	53	54	55	56	57	58		
T	S	I	E	O	E	N	S	I	B	S	E	T	Y		
59	60	61	62	63	64	65	66	67	68	69	70	71	72		
O	O	F	N	L	D	O	I	W	T	A	E	N	N		
73	74	75	76	77	78	79	80	81	82	83	84	85	86		
D	D	N	F	O	T	T	M	T	K	O	T	F	C		
87	88	89	90	91	92	93	94	95	96						
R	Q	E	M	E	A	Z	T	E	G						

Now take the even numbers and put the letters that are under them in order to make another phrase.

Now try this. Take the multiples of 2. What message?

Take the multiples of 5. What message?

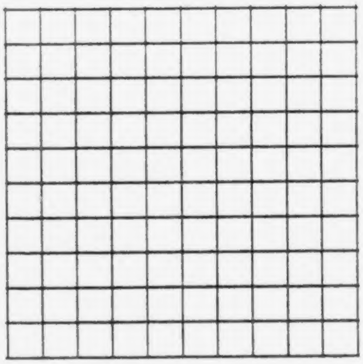
Now a problem for you. Can you create a "code" (such as that above) such that the multiples of 2, the multiples of 3 and the multiples of 4 give (three) coherent messages?

Seeing Patterns on a 10x10 Grid

Helen Jones

Introduce mathematical concepts like patterns, pairs, odd and even numbers by using a 10x10 grid. Give each child a grid and crayons. Try these activities. Color every second square. On a separate grid color every third square. Every fourth. Compare different patterns.

Variation: Frequencies can be recorded too. Roll one die. Record each roll by coloring the correct number of squares. Use a different color for each number (die face).

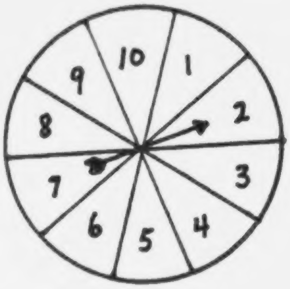


Multiplication Snake

Janice Halley

Mary Parrish

This is a good game to play with intermediate elementary school children who have an understanding of multiplication. Player number one spins the spinner. He must move his marker to the first multiple of the number that the spinner lands on. (Markers may be bingo chips, pieces of paper, etc.) The next and all other players follow in the same manner until the last player reaches the end of the snake. The player with the highest score wins.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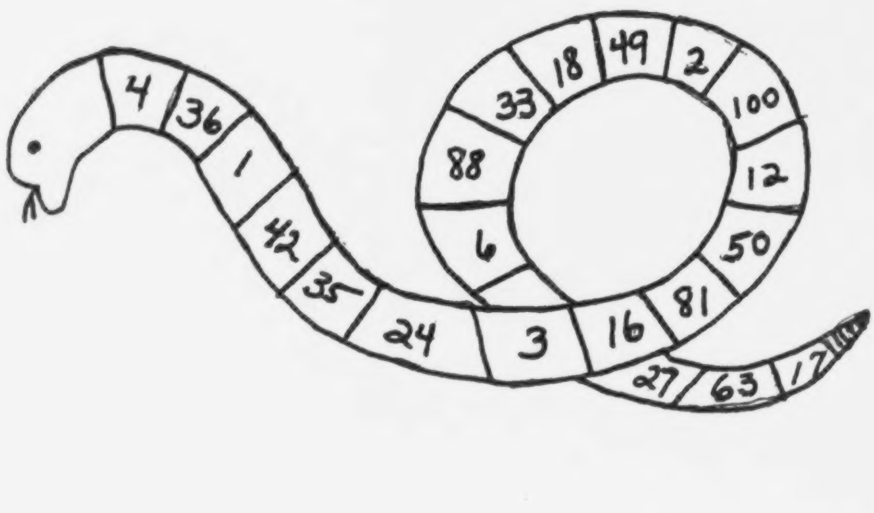
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Why So Many of Us are "Bad" at Math*

Eugene Maier

Many people understand mathematics, yet don't understand that they understand. They know, but they don't know. It is this, I believe that inspires much of the needless apprehension and unease many people feel toward mathematics.

Let me explain by means of a couple of examples.

A student once asked me to help her with an arithmetic problem based on an advertisement. A dress was offered for sale at 20 percent off the list price. The sale price was $60. The problem was to find the list price.

I asked this student to tell me her difficulty in solving the problem. I was surprised when she promptly told me the solution and explained how she found it.

"The sale price of $60 was 80 percent of the list price," she said. "So 20 percent of the list price was one-fourth of $60, or $15. Adding $15 to the sale price of $60 gives the list price lf $75."

"That's right," I said, a little baffled. "What is it you want to know?"

"How do you do the problem?"

"I don't understand. You just did the problem."

"No, I didn't," she insisted. "What's the formula?"

As we talked further, the realization dawned on me: she believed she didn't know how to do the problem unless she plugged numbers into a formula. She had correctly solved the problem, but couldn't believe she had. She knew, but thought she didn't.

Another example: Once when I was cashing a check, the bank teller noticed that it was issued by the Oregon Mathematics Education Council.

"Oh, mathematics," she said with a grimace. I asked about her reaction. "Mathematics was my worst subject," she said. "I never was any good at it."

She paused, then was struck by the incongruity: a bank teller bad at mathematics. She quickly tried to reassure me that she was a capable teller and actually quite good at mathematics.

She told me that she didn't know mathematics, and that she did. Almost in the same breath. "I know, but I don't know."

I observe this phenomenon often. I see it in well-educated people who handle the mathematics of their daily lives without difficulty. Yet they disclaim any mathematical ability, vowing it was their worst subject in school. I hear about this phenomenon from parents who tell me their children are hesitant and unsure when they do school arithmetic assignments. Yet in playing board games at home, these same children handle the necessary arithmetic with aplomb and dispatch.

Observations like these have led me to conclude that when people say they don't know mathematics, though they demonstrably do, they're referring to some special kind of math - school math. For these people, the math they learned (or failed to learn) in school is completely unrelated to the math they use in their everyday lives - the math I've dubbed "folk math."

I want to suggest some reasons many people see little or no connection between these two brands of mathematics. My conjectures are based on recent research into how people learn, particularly into how the two hemispheres of the brain play different parts in the process of learning.

The human cerebrum - the large front portion of the brain, the seat of conscious mental activity - is divided into halves or hemispheres. The two hemispheres, the right and the left, are joined only by a band of nerve fibers, known as the corpus callosum.

Over the past century, psychiatrists and psychologists have noticed that when one of the cerebral hemispheres is damaged, or when the corpus callosum is severed, a person's mental abilities will change in fairly predictable ways. Damage to the left brain is likely to impair the ability to speak and write. Damage to the right brain may affect spatial reasoning, the ability to sketch objects or physically manipulate them.

The corpus callosum has been severed surgically to control seizures in some persons suffering from severe epilepsy. In these persons, the two halves of the brain appear to work in isolation, the right brain guiding the left side of the body, the left brain guiding the right side. Such persons are able to perform visual, spatial tasks only with their left eye and hand, tied to the right brain. Conversely, they can name or give verbal description only to those objects seen or touched with the right eye or hand, tied to the left brain.

Thus the left brain seems predominantly involved with rational, analytic, sequential, logical tasks. It arranges words into sentences, does mathematical computations, and puts quantitative measures on phenomena. It dissects knowledge into sequential, bits and pieces.

The right brain appears to deal with information in intuitive, global, relational ways. It recognizes shapes and faces, is responsible for spatial orientation, and has creative flashes and insights. It forms overall impressions or "gestalts" from diverse bits and pieces of data.

How do the two hemispheres relate in [illegible] undamaged brain?

"In most ordinary activities," says Stanford psychologist Robert Ornstein, "we simply alternate between the two modes, selecting the appropriate one and inhibiting the other." Ornstein's research into the patterns of brain activity suggests that the complementary working of the two hemispheres, and of their two modes of thought, underlies our most creative accomplishments. Bob Samples, a humanistic psychologist, argues that our psychological health depends on our attaining an equilibrium between the two modes of thought, on not allowing one mode always to dominate.

This theory about the two modes of thought and how they work together appeals to me. It provides a framework into which my own experiences, observations, beliefs, and hunches about the teaching and learning of mathematics fit nicely. And perhaps this theory explains the phenomenon of "I know, but I don't know." I have an idea why many people find little connection between school math and folk math.

I suspect these people do their folk math using both hemispheres, both modes of thought, in a complementary way. They shift back and forth between hemispheres as needed. They possess a good, intuitive, right-brain sense of how numbers work. They translate that sense into appropriately analytic, symbolic, left-brain computations. The problem is solved.

But for these people, school math is not intuitively sensible. In school, right-brain thinking seems not to apply. School math instead is a sequence of abstract, isolated, linear tasks, tasks momentarily memorized, tasks whose meaning or significance is never directly experienced and never fully understood. School math is for the left brain only.

These people - they may constitute a majority of humankind - have two divergent understandings of mathematics, two concepts that are at odds. Their left-brain knowledge of math, mostly acquired in school, doesn't fit and perhaps doesn't even connect with their right-brain knowledge, acquired mostly outside school.

This may be why, if the National Assessment of Educational Progress can be believed, many U.S. school children can perform basic arithmetic as taught in school, but cannot apply that knowledge to simulations of "real-world" mathematical problems. This also may be why many people find mathematics in school an ugly, painful, frightening thing, to be avoided at any cost.

How does this happen? Why this gap between school and life?

Not long ago I visited a first-grade classroom during arithmetic time. The teacher asked someone to write the numeral "five" on the chalkboard. A little girl volunteered. She began writing it legibly, but not precisely in the way taught in class. I thought she did the task in an acceptable way, but the teacher told her she was wrong, without explanation. Another child was called on, who used the "right" method and received the teacher's approval.

I wonder about that little girl. I'm sure she since has learned the standard school method, which is fine. But I wonder what else she has learned. Her method appeared as efficient and reliable as the teacher's, and apparently it had emerged from her own experience, her own sense of how numbers work. Yet she was told her method is illegitimate. Implicitly, she was told that her experience is illegitimate, that it doesn't apply in school. She was told - or at least her right brain was told - that school math is a miscellany of arbitrary, capricious rules, rules that don't make sense.

The teacher was not at fault. Teachers have long been taught that mathematics - and almost everything else - is most easily learned in little bits and pieces. This is the one belief shared by proponents of various educational fads, from "competency-based education" to "individualized instruction." The smaller the bits, the easier learning is thought to be. Mathematics is thus reduced to a vast number of rules pushing symbols about with pencil and paper.

But the parts are less than the whole. Teachers and students become so immersed in procedures that they lose sight of what is important. The ability to analyze problems, to grasp relationships, to intuit possible solutions - all are forgotten as students and teachers slog through a rigid hierarchy of largely meaningless skills. They lose any sense of the sense mathematics makes.

School math thus becomes a wholly left-brain activity, clean and logical, but sterile, abstract, and uncreative. Students come to regard math as painful, and teachers learn to tolerate it as dull.

Outside school, confronted by an actual, practical problem requiring some mathematical thinking, teachers and students alike may find themselves helpless, unable to perform the right-brain task of "seeing" how bits of school math might be combined into a solution. Their ability to cope with living is diminished.

Or else they may solve the problem by shifting to their right brain, their folk math, developed through experience and maintained despite the almost constant efforts of educators to repress it. Then they merely are cut off from a large part of our cultural heritage. They are unaware that the thinking involved in their folk math is actually closer to the wellsprings of human knowledge than the school math they fear and despise.

I reflect on my own mathematical training. I've succeeded at lots of school math, which I pursued through to a doctorate. But much of the math I studied I comprehended only in a left-brain way. I mastered logical connections, analytic methods, and technical language. I passed tests. But I had no intuition, no feeling, no "big picture." Only those mathematical topics that I messed with and mulled over, that I could envision graphically, that I had an intuitive sense for, a sense of the whole - only those topics did I truly understand, only those topics could I see in new or creative ways, only those topics could I make new discoveries about. I knew them in my head and I knew them in my bones.

If making confident and creative use of mathematics depends on both right- and left-brain thinking, then school ought to encourage both. How might this be done?

First, school could honor intuitive and visual thinking as valid and useful accompaniments to rational and analytic thought. Appearances can be deceiving, but so too, unsuspected errors may lie hidden even in the most elegant deductive proof. In solving a problem, mathematical or otherwise, I find that mental images, intuitive hunches, and just plain guesses often suggest a likely strategy for finding a solution. Schools could be less concerned with mechanics and procedures. Schools could be more concerned with providing children experiences likely to nurture their abilities to think.

Second, school could allow mathematics to emerge from students' own experience. Too much of school math is tied to some imagined future event, and introduced because someone thinks students will need it someday. Such prophecies often turn out badly. But in any case, children cannot intuitively understand mathematical situations or problems they have never encountered themselves. Schools could draw on children's mathematical experiences, and foster further experiences, as a basis for mathematical teaching.

Finally, school could encourage children to use the valid arithmetical methods they have figured out for themselves, based on their own experience. If these methods are slow or awkward, then quicker, more elegant ones may be offered as alternatives. Certainly children should not be made to think that a workable method is invalid merely because it is different. Above all, the importance and integrity of a child's own intuitive and reflective efforts to make sense of numbers and the world ought to be respected.

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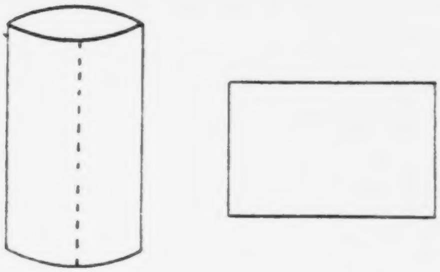
*This article by Eugene Maier of the Math Learning Center is taken from Mathematics in Michigan, Vol. XIX, No. 1, September 1979. Reprinted by permission.

Cylinder - Rectangle/Square

Linda D. Tholl and Judy Chapman

Take an empty bathroom tissue roll or paper towel roll and have the children cut a straight line up the cylinder and lay it out flat on the table. This will illustrate that a cylinder is merely a flat rectangle or square.



[Editor: What do you get if you unfold some other ordinary itmes--a lampshade, a football, a Coke bottle (how to do that?)]

Building and Estimating

Linda D. Tholl and Judy Chapman

I. Using toothpicks and glue build the following:

Square

Rectangle

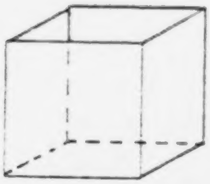
Triangle

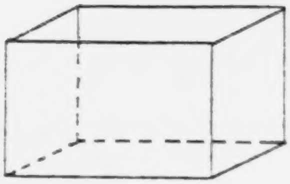
II. Here are some figures:

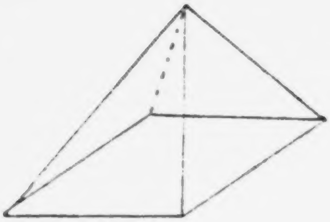
Square box

Rectangular box

Pyramid







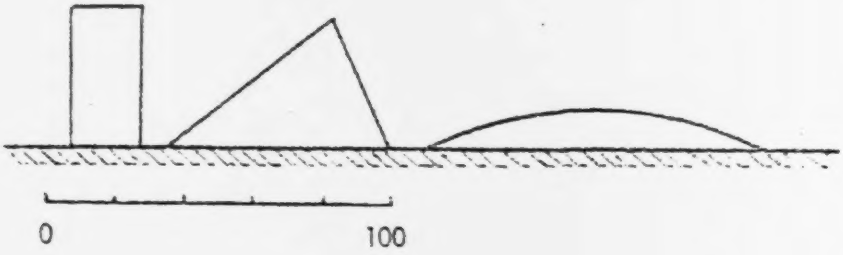
In set I, how many toothpicks did it take to build the square? the rectangle? the triangle?

In set II, how many toothpicks will it take to build the square box? the rectangular box? the pyramid?

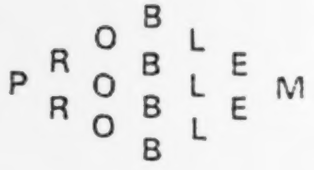
From THE PROBLEM SOLVER*

A farmer has 100 metres of wire fencing which he wants to use to surround as much area as possible against a long straight wall, which is shaded in the diagram below.

The figure shows three rather poor attempts to solve the problem. Can you find better solutions? Can you find the best possible solution?



In how many different ways can the word PROBLEM be read from left to right in this diagram?



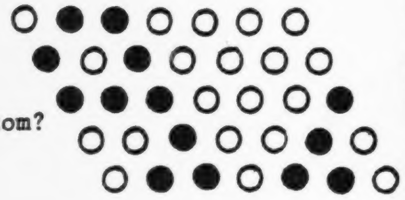
This pattern starts with the top row and works downwards. Each row is worked out from the row above it, by the same rule.

What is that rule?

What will happen if you work out more rows from the bottom?

Will the pattern ever repeat?

What happens if you start off with different circles in the top row? With a different number of circles?



Why are pencils hexagonal or round, rather than square?

You have 2 parents, 4 grandparents, 8 great grandparents, 16 great great grandparents ... and so on. If each generation on average lives 25 years further back in time, how many great great great great ...... great grandparents did you have in the year 1080? Compare your answer to the total number of people in the world at that time.

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* THE PROBLEM SOLVER is published once a term by Rain Publications, 194 Goldhurst Terrace, London NW6. The editor is David Wells.

It's an Eskimo house. There's a bird. [illegible]'s a girl and it's raining. She's eating. She's going outside. She Said it's snowing. Now it's summer. I wished it was winter.

Geo

Dianne Anthony

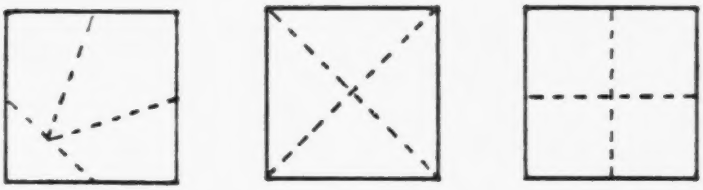
Number of players: 3 teams with 4 or 5 players each.

Materials: 1) One gameboard for each team.

2) For each team, a set of three squares or rectangles cut into four pieces each. Each square or rectangle matches the size of the squares or rectangles on the gameboard.

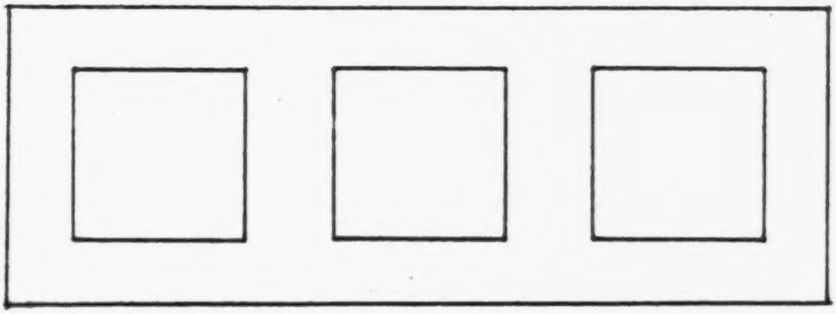
Playing Directions: Three teams should be formed. Each team should have a gameboard and an envelope containing three cut-up squares or rectangles. The members of each team divide the pieces among themselves. The teacher or a pupil-appointed leader gives the signal to the teams to begin, and each team attempts to assemble the three squares or rectangles by fitting the geometric shapes on the gameboard. Each member of the team may use his pieces or those of his fellow team members. The first team to assemble all three squares or rectangles wins the game.

Cut on dotted lines.



Geo

Gameboard



Twelve Year Old Wisdom

Mary Steffen

Children have a marvelous way of finding the truth in the muddled reality of our everyday world. Recently a classroom group discussion modeled after William Glasser's "Schools Without Failure" merged with a collaborative writing assignment motivated simply by my saying, "Two to three people, choose your own topic, your audience is the general public." I share the sobering ideal these twelve year olds set forth for the teaching profession because it is a tough goal to handle alone.

The Perfect Teacher

Dara Bremerkamp
Kristi Cisel
Donna Glennie

The perfect teacher should be someone who is understanding. The perfect teacher should listen to someone when they explain something and just shut out other people. A teacher shouldn't have a pet or a scapegoat. A teacher shouldn't tell someone to go away if they need help. A teacher is the kind of person that you should trust. A good teacher is someone who understands you. A good teacher is someone who trusts you. A teacher shouldn't force the kids to do their bad deeds. A good teacher shouldn't give a lot of homework and never give you time to do it. A good teacher should appreciate your good work.

IMPLICATIONS OF PIAGETIAN THOUGHT FOR EDUCATION *

** Presented at The First Brazilian Congress on Piagetian Research and the Development of Intellect, Rio de Janeiro; September 1980.*

Thomas C. O'Brien
Teachers' Center Project
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Edwardsville, Illinois

I speak to you as a teacher, not as a psychologist. I have, to be sure, done some small research on logical necessity and on the development of number concepts but the major part of my last twenty years has been given to work with teachers and to curriculum development in hopes that school education might become healthier and that the life chances of children might be richer.

I speak to you as a person whose life and career surroundings are just as distant from Geneva as yours. Most of my knowledge of Piaget-oriented thinking has had to come from books, from my observations of my own children, and from my very highly prized contacts—two or three times a year—with authentic Genevans. What I am saying is that if some of what follows makes sense to you, it is possible that you can elaborate it, extend it, or build your own version of it on your own local ground.

I speak to you as a bridge builder. It is clear to me that the Piagetian psychologists and epistemologists have done work of vast importance to teachers, but it is also clear that you and I —educators— must build bridges between the theory and the research (on one hand) and what happens in schools (on the other).

Let me begin. What follows are several issues which seem to me to be important as one considers the relations between Piagetian thought and the education of children.

At the beginning, let me state my view that there is a great difference between the applications of Piagetian work to education and the implications of Piagetian work for education. A great many people I've met look to the Piagetians for ready-made applications--recipes or formulas ready for quick adoption to educational settings. These people are misguided, I think, and they are doomed to disappointment. On the other hand, the richness of the educational implications of Piagetian research is very great.

Perhaps the most important question is this: Should we take a boat? Or a bicycle? Or perhaps we should go by train? No, let's go by car! If you listened closely, you must think that I'm some sort of madman. What do boats or bicycles or trains or cars have to do with Piaget or with education?

Suppose someone were to ask you, "How shall we get there? Shall we go by boat or bicycle or train or car?" Of course, you would reply, "Where is it that we are going?" For Paris, a car isn't so good. For New York, a bicycle probably wouldn't do. For Nilopolis, right down the road, a bicycle would be ok, but a boat wouldn't do at all.

My point is that educators need constantly to ask, "Where am I going?" and _then_--it is a dependent question--"How do I get there?" My feeling is that all too often we ask the "How do I get there?" question first and we wind-up--American education is dominated by this--with bits and tricks and laundry lists, much of which arrive on bandwagons. (A British friend of mine has defined a bandwagon as "The fastest vehicle in a vacuum.")

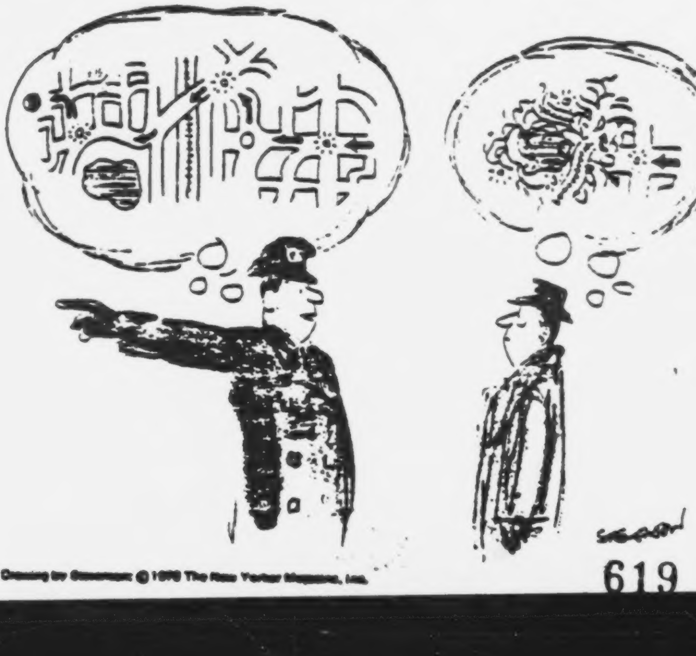
It seems to me, then, that it is important to distinguish between ends and means in education. It is important, to argue out one's ends and then to construct means which are informed by them and which serve them. Much of our work with teachers in the St. Louis area concerns the question, "Why have schools?" I'll ask _you_. What is the purpose of education other than to keep kids off the street? It is not a trivial question. It involves one's deepest ideas of what it means to be human and what it means to be a community. It takes, I think, a lifetime and more to work out the answer to this question.

A Piagetian point of view informs both the question of means and the question of ends. Let me try to shed some light on such a claim.

Perhaps the most important educational implication of Piagetian research is that children—in fact, all of us—are agents, not patients, in knowing. The child is not a passive bin to be filled with external stuff, like lumps of coal, called knowledge. Rather he or she is a constructor of knowledge—a weaver, if you will, of the entities of environment, inference, experience, and imagination—and the weaving and the fabric tend toward coherence, stability, economy and generalizability.

Such a view of children—of humans in general—runs counter to the dominant (North American?) view of people as receptors, pawns, and patients, whose only important intellective activity is storage. What I say here, though I often use the word "children," applies to all of us who are capable of growth. In particular, what I say applies to secondary and university students (whose teachers, world-wide, seem to regard knowledge as static stuff and students as receptors/pawns/patients).

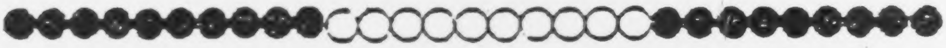
Perhaps Mimi Sinclair said it best on a recent visit with my teacher-friends in St. Louis: "We should see children as though they were wearing sign-boards saying "under construction—self employed.""



Drawing by [illegible]; © 1970 The New Yorker Magazine, Inc.

There is not much time here to give to a defense of the view of the child as a constructor of knowledge. Read Piaget and try some of his tasks with children. And for everyday, informal evidence take a look at the natural language a five-year-old in any culture has constructed without tutelage, 2) watch a child learn to ride a bicycle or 3) look at the constructions that you and your colleagues have made of Rio, of this campus, or of the very words you've heard in the past few minutes.

A work session: Static vs. dynamic knowledge



Dynamic Knowledge:

1. derives from action--mental or physical or both
2. can be reconstructed
3. leads to new knowledge

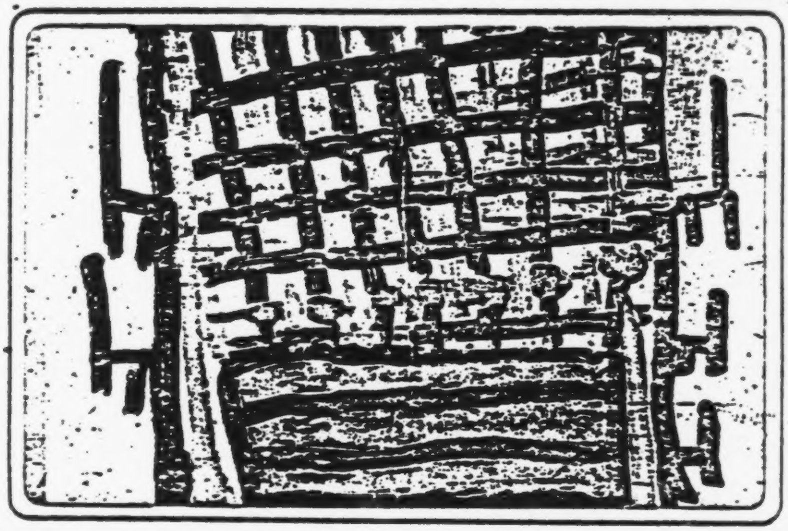
Another work session:

1. I am thinking of a number
2. I am thinking of two numbers
3. The 2-4-6 problem (from P. C. Wason)

My experience is that schools, by and large, deal with static knowledge, largely concerned with adult-grown rules, conventions, procedures, facts, nomenclature and--in mathematics and language--notation.

If knowledge is a personal construction of actions--physical and mental--and if the growth of knowledge involves the coordination and elaboration and differentiation of actions, it is unfortunate at best and tragic at worst that schools see education as the transmission of static stuff.

The next issue of importance for educators is obvious; children's thinking is not only different in quantity from adults it is different in quality. The best lecture I can give—though I have written at length on the issue— is to invite your attention to the following seven-year-old's piece of art:



This artwork, done by my daughter when she was seven, shows a birthday cake and a striped tablecloth on a table surrounded by chairs. Need I say more about children's construction and coordination? Enough of "children". What about secondary/tertiary students' construction of relationships?

Actually, there are three points to be made; the first is that we are uninformed and egocentric if we continue to view children as less-full versions of ourselves. The second is that recent research—I'll mention just the work of Mimi Sinclair, Mieko Landy and Emilia Ferreiro—makes it clear how much rich knowledge remains to be gained on children's construction of thought in ordinary situations such as playing with toys, arithmetic place value and simple written language. Third, it is clear that research on children's construction of knowledge is not—indeed cannot be—the exclusive province of psychologists. Teachers must be researchers as well.

Let me take a moment to expand on the last issue, the teacher as researcher. It is essential, I think, that teachers do research on children's construction of reality for three reasons. In general, teachers themselves need to construct a point of view with respect to children's knowledge. They need to be agents, not merely patients (and storehouses of already-done research) in this construction. It is a life-long construction. Second and narrower, teachers need to know much more about the result of a child's thinking—an answer to a test question, for example—in order to assist thoughtfully in a child's growth. To know how the child constructed his or her answer is essential to a teacher's intervention, lest we limit ourselves to the trivial tallying of "rights" and "wrongs".

Let me tell you a story here. A teacher asked a five-year old child, "What's 9 plus 9?" The child responded, "19." What would you have done? One alternative would have been to say "Wrong. It's 18. Write it out a hundred times." The teacher, however, went further: "How come 19?" "Well," said the child, "Nine is one less than ten, and 10+10 is 20. So 9+9 is 19." What marvelous thinking from a five-year old! The structural soundness of the argument, masked by a clerical error, was uncovered only by the teacher's probing. (What would you next do if you had been the teacher?)

Third, it is clear to me that teachers can be fruitful partners of the university researcher. Very often teachers have insights into children's ways of seeing the world that are far richer, far more practical, and far more adventurous than those of the laboratory-bound researcher.

Much of what I have said here has been concerned with broad aspects of education as a Piagetian point of view informs them. I suggest that the purpose of education is to cause intellectual growth to occur, not merely to "install" in children (or adults) facts, rules, procedures, nomenclature and conventions. What is important is to encourage children to organize, to coordinate, to pull into coherence the disparate entities of environment, experience and inference and to regulate between one's own internal networks and the demands of external reality. The issue is simply and beautifully described by the British educator, Molly Brearley:

> *The main work of the school is surely the fostering and developing of mental life, enabling children to experience more fully and consciously all that life has to offer. This large, overall aim is to be achieved by an infinity of small steps. The material we provide children can seldom be thought of as an end in itself but rather as a means through which effective thinking and feeling are fostered.*

Another break: "Will the tiger bite?"

Because of time limitations and because it is, quite properly, a job in which we must all collaborate, I will not go into detail concerning the "How to get there" of education. I have done twelve books which may push the issue along a bit and in the appendix I list a number of resources which might be helpful. It is fair to say, however, that a great deal of work needs to be done.

It would be foolish, however, to rush along without pointing up the primacy of three aspects of "How to get there":

1. Action—physical and mental—is essential to the growth of knowledge
2. Moderate mismatch is essential to the growth of knowledge. Dissonance —whether from novelty, surprise, argument, serendipity or quest—is at the heart of learning.
3. Collaborative work among learners--frowned upon as "cheating" in many schools—is one of the major contributors to intellectual growth. Children, I'm sure, learn most of what they know from one another.

One issue not widely addressed in the Piagetian literature is the role of context in intellectual growth in general and in the armament that a person brings to a particular situation. Here I would point you toward the research of Margaret Donaldson (Scotland) and Peter C. Wason (England) and to the curriculum development of A. I. Weinzweig and James T. Robinson (USA), where the impact of context is shown to be simply undeniable.

One conflict I am sure you are aware of is the conflict between percept and concept. (Let me tell you a story here with which you might feel some sympathy. Last winter I drove my wife to work because her car was frozen solid--dead battery and all--in our driveway at home. Leaving her at her office, I drove to my office. Enroute I passed by a car like hers--a Volkswagen, same type and color and age. I knew that her car was dead in our driveway and I had just let her off at her office, but I couldn't resist looking at the passing Volkswagen to see whether it was my wife who was driving.)

The conflict I'm talking about now, though, is not the widely known conflict between percept and concept. It's the conflict between logic and context. It's not a conflict; it's a domination. Context wins. To give an example of the role of context, let me pose for you one of Peter Wason's many lovely problems:

> *Re-write in simpler language the following instruction, which was posted on a hospital note-board:*
>
> *No head injury is too trivial to be ignored.*

Piagetian research it seems to me, reverses things. The usual research question is "What is the effect of the stimulus upon the organism?" (I give this group vitamin B, this group vitamin C, this group vitamin Q, this group no vitamin. What is the effect of the vitamin on the patient?) Piagetian research asks the backwards question, "What is the effect of the organism on the stimulus?" What does the human being make of the world and how does that making evolve?

Similarily, educators might well take a backwards and much more productive view of schooling. The usual view is "How can I arrange things so that they act on the pupil?" The "backwards" question may be better: "How can I arrange things so that the pupil acts on them; relates them, explains them, extends them . . . knows them?

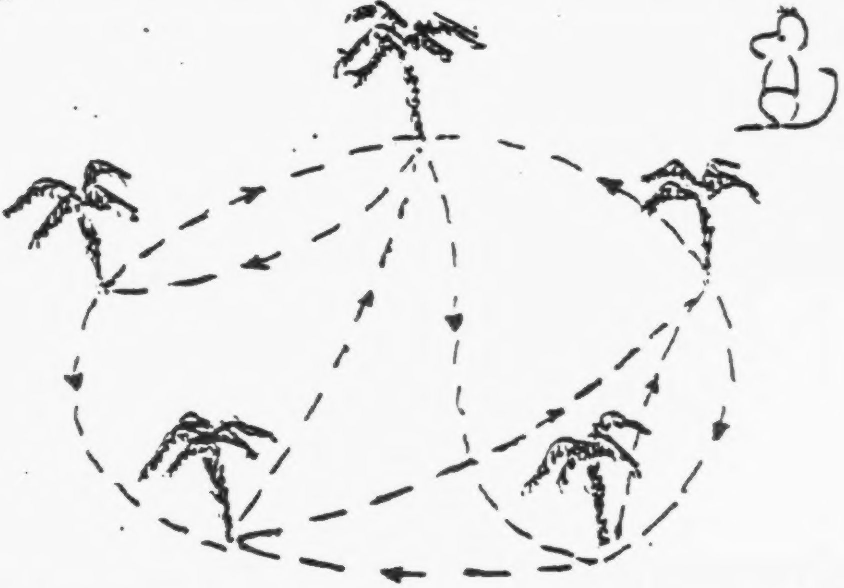
The motto of my project in the St. Louis area is "Knowledge is not a spectator sport". The motto owes much to George Polya, the great Hungarian problem-solver, and to Jean Piaget and his colleagues throughout the world. I think that that motto, "Knowledge is not a spectator sport," summarizes in six words Piaget's message to educators..

If what I have said makes sense to you--and I'm sure, given that knowledge is a personal construction, that it means many different things to many different people, I encourage you, my fellow educators, to act organismically in reconstructing, elaborating and extending the things that you have heard. Do not, please, act mechanistically. Knowledge is not, in fact, a spectator sport.

APPENDIX

Here are some classroom activities drawn from (or related to) our local work which show a constructivist point of view in action.

1. A monkey went from tree to tree as shown. Where did he start? Where did he finish?

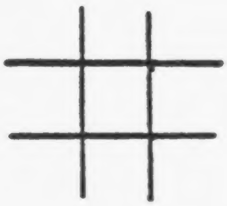


(By Dr. Jerzy Cwirko-Godycki, Warsaw, who used this problem at the Eighth Annual Teachers' Center Residential Course, August 1979.)

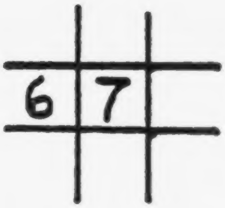
2. How can you, without using a compass, find out where North is? How many ways can you find to solve the problem?

(From T. C. O'Brien, Solve It, Book 5, Chicago: Educational Teaching Aids, 1980)

3. Fill in the grid with numbers, duplicates allowed, so that each of the rows, columns, and diagonals add up to the same number. What can you find?

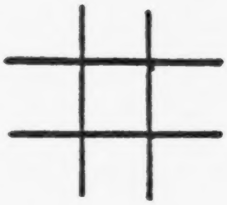


Now try this one. Some numbers are already given and the total to try for is 21. What can you find?



(From SEEDBED 4, a production of the Teachers' Center Project. Southern Illinois University, Edwardsville, Illinois)

4. One player is X, the other is O. Each player makes his or her mark on the grid in turn. The player with three X's or three O's in a row is a loser.



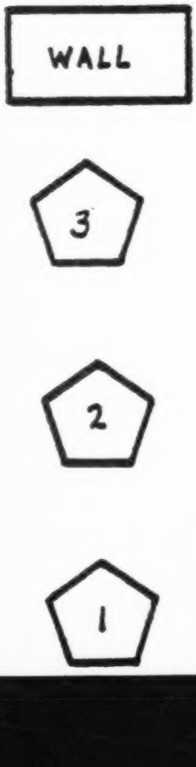
(From T. C. O'Brien, Solve It, Book 5, Chicago: Educational Teaching Aids, 1980)

5. Three men stood facing a wall as in the diagram at the right. They stood so that all they could see was the person(s) in front of them.

From a pool of 3 white and 2 black hats, one hat was randomly selected for each man. Therefore, the only hat(s) that any man saw was/were in the man/men in front of him.

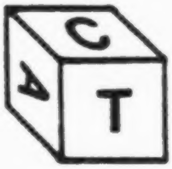
The first man was asked if he could tell what color hat he had on. He replied that he could not. The second was asked the same question, and even though he had #1's answer to help him. he also replied negatively. When #3 was asked he immediately said, "I have a white hat on my head!" How did he know?

Variation: What would happen if the order of responses was reversed if #3 responded first, #2 second and #1 last? Would it make a difference? What other variations are possible?

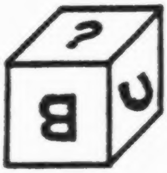


(From SEEDBED 5, a production of the Teachers' Center Project. Southern Illinois University, Edwardsville, Illinois)

6. Start with this cube.



Each of these cubes has a question mark. What goes in the place of the question mark? Be careful. Watch for doubles.

1


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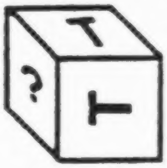

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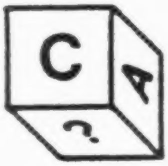

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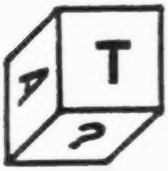

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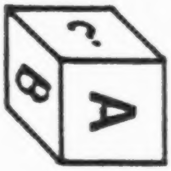

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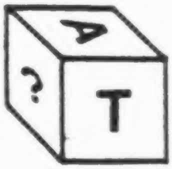

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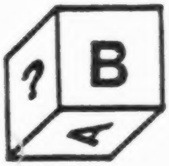

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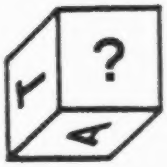

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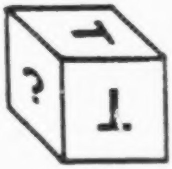

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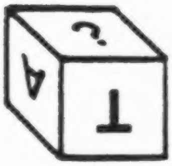

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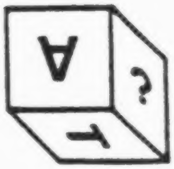

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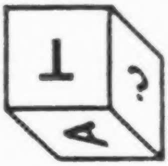
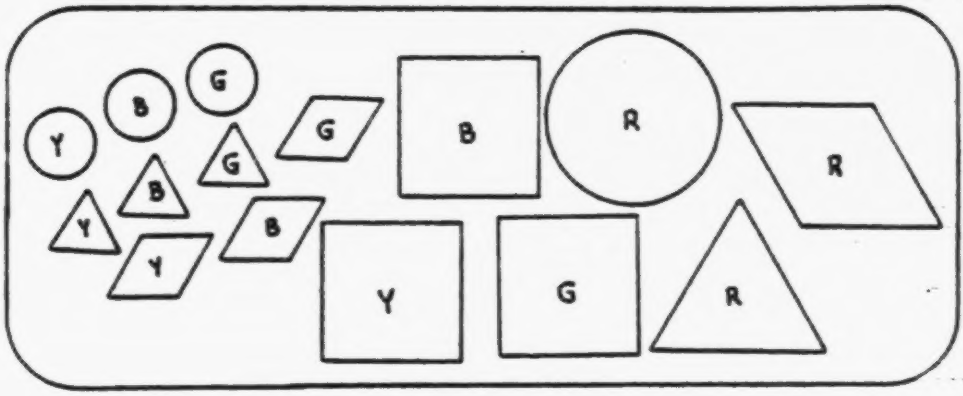


(From T. C. O'Brien, Mathematical Brain Teasers Books 1-5, Chicago; Educational Teaching Aids, 1980)

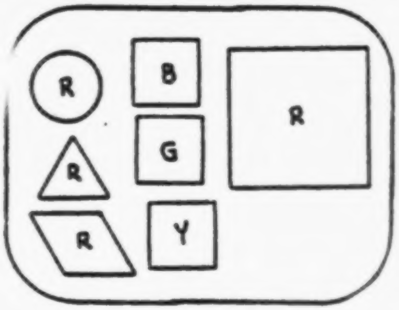
7. With a complete set of Attribute Blocks you can select a block, then make sets which have one, two, or three differences from the original block.

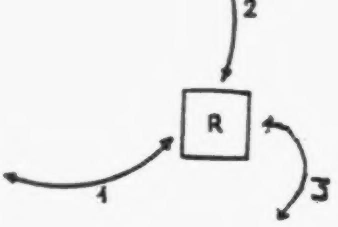
②



If you have a small red square than you can find three sets of blocks:
1) All blocks in this set have one difference.
2) All blocks in this set have two differences.
3) All blocks in this set have three differences.

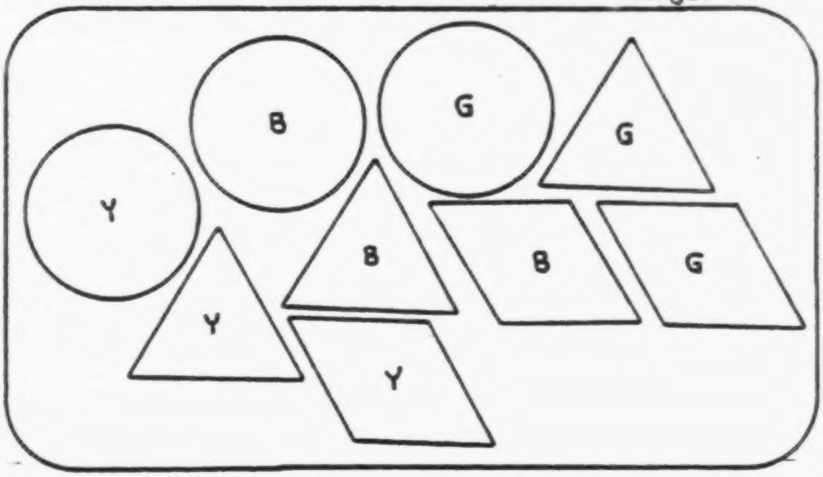
①





If you change the small red square to a different block, will the number of the elements in each set remain the same or change?

③



(By Jerzy Cwirko-Godycki, Warsaw, Mathematical Activities from Poland II, available from the Teachers' Center Project, Southern Illinois University, Edwardsville, Illinois)

8. What's missing?

+	14	15
5	○	○
6	○	○

Number Patterns:
Across________________
Down________________

+	○	9
2	○	○
○	8	12

☐ Impossible
☐ Several answers
☐ Exactly one way

+	4	○
○	9	15
○	11	○

Number Patterns:
Across________________
Down________________

+	○	○
3	○	11
7	○	○

☐ Impossible
☐ Several answers
☐ Exactly one way

(From T. C. O'Brien, Puzzle Tables, New Rochelle, New York: Cuisenaire Company of America, 1980)

9. Is the greatest painter who is a poet the same as the greatest poet who is a painter?

How about the oldest poet who is a painter? Same as the oldest painter who is a poet?

(From T. C. O'Brien, Solve It, Book 5, Chicago: Educational Teaching Aids, 1980)

10. A family of five in your town would like to take a weekend trip. They want to spend no more than $100. Plan a trip for them. Be as imaginative as you can.

(From T. C. O'Brien, Solve It, Book 5, Chicago: Educational Teaching Aids, 1980)

11. **Completely cover this 5 by 6 grid using dominoes:**

4 - 3, 2 - 2, 2 - 0, 1 - 0, 2 - 1, 3 - 3, 1 - 4, 4 - 4

2 - 4, 3 - 0, 3 - 1, 0 - 4, 1 - 1, 3 - 2

4	3	2	0	0	2
4	1	3	4	0	3
4	2	3	1	0	1
4	2	1	2	2	3
0	4	1	3	0	1

(From SEEDBED 3, a production of the Teachers' Center Project. Southern Illinois University, Edwardsville, Illinois)

Further Readings for Parents and Teachers

Practical Applications. Here is a brief list of books which teachers have found helpful. Because relatively little work has been done in other areas, they tend to be concerned with mathematics (very broadly defined) and with science.

Association of Teachers of Mathematics, *Mathematics Teaching* and various other publications. Nelson, Lancs.: Association of Teachers of Mathematics

Bates, J., et. al. *Developmental Math Cards*. Don Mills: Addison-Wesley (Canada) Ltd., 1973.

Biggs, E. E. *Mathematics in Primary Schools*. (Schools Council Curriculum Bulletin No. 1). London: Her Majesty's Stationery Office, 1972

Brearley, M. (ed.) *The Teaching of Young Children*. New York: Schocken Books, 1969.

Biggs, E. E. and MacLean, J. R. *Freedom to Learn*. Don Mills: Addison-Wesley (Canada) Ltd., 1969.

Barretta-Lorton, M. *Mathematics Their Way*. Reading, Mass: Addison-Wesley Publishing Company, 1976.

Biological Science Curriculum Study, '*Human Sciences Program*. Boulder: Biological Sciences Curriculum Study.

Coppele, C., Sigel, I. and Saunders, R. *Educating the Young Thinker*. New York: D. Van Nostrand Company, 1980.

Educational Development Center, Inc. *Unified Science and Mathematics for Elementary Schools*. Newton: Educational Development Center, Inc.

Elementary Science Study. Various Publications. New York: McGraw Hill Book Company.

Lowery, L. *Learning About ... Series*. Berkeley: University of California, 1974

Ministry of Education, *Education in the Primary and Junior Divisions*. Toronto: Ministry of Education, 1975

Mountainview Center for Environmental Education, *Outlook* and various other publications. Boulder: Mountainview Center.

Nuffield Foundation, *Nuffield Mathematics Project*. New York: John Wiley & Sons, Inc.

O'Brien, T. C. *Solve It*. (Books 1 - 5). Chicago: Daigger/ETA, 1977.

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Paper Race

Jeanne Edgar

Maybe you have always wanted to be a race car driver. Here's your chance. Get your crash helmet. Get your pencil. Join the paper race. It's easy to do. Just move on down the road. Use a pencil to show your car's route.

These are the rules. Two or three players can play.

1. Use a straight line to record each move.

2. There are two parts to each move.

    A. the number of units right or left
    B. the number of units up or down

3. You have to speed up or slow down gradually, just like a real car.

    A. Each part of a move can be one more or one less than it was your last turn.
    B. Each part can be the same as it was your last turn.
    Example: Say part of your move is 2 to the right. Your next move can go 1, 2, or 3 to the right. (You can't go back to the left until you slow down to a zero move.)

4. You crash and the race ends if:

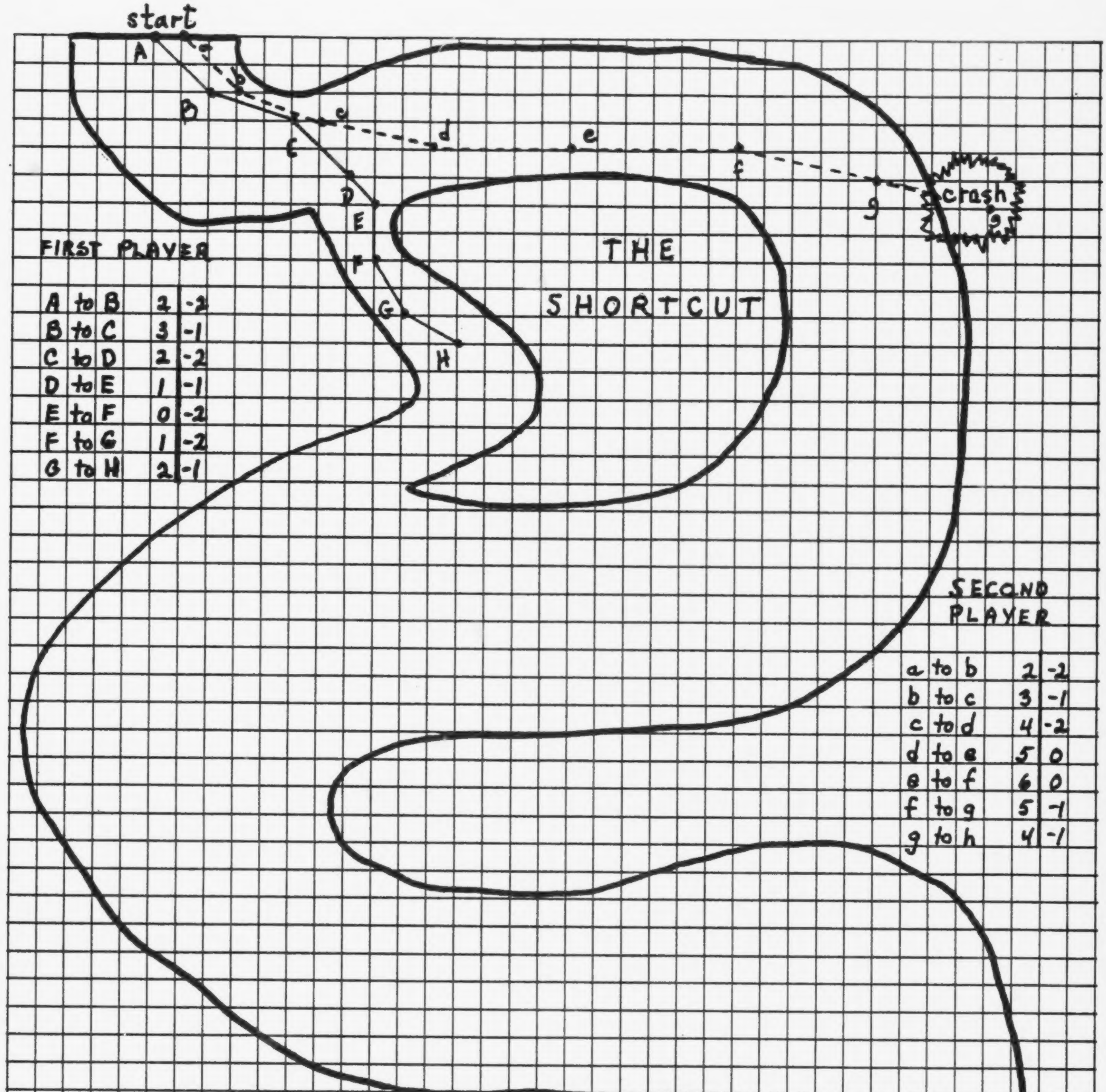
    A. both cars land at the same point on the same move. The second car to land on that point loses the game.
    B. your car goes off the track.

5. Begin with any move you wish.

Look on the next page for a sample race. The chart explains "Your Moves".

Another version of this game is to play it by yourself. Count how many moves it takes to go from start to finish without running off the course. Try to break your own record and complete the course in fewer moves than before.

This neat game is from the November, 1980 issue of Scholastic MATH Magazine. This race track is an original one drawn up by one of my 7th grade students, Jackie Bush. I nicknamed it "The Shortcut".


start
A
B
C
D
E
F
G
H
a
b
c
d
e
f
g
crash
THE
SHORTCUT
finish

FIRST PLAYER

A to B	2	-2
B to C	3	-1
C to D	2	-2
D to E	1	-1
E to F	0	-2
F to G	1	-2
G to H	2	-1

SECOND PLAYER

a to b	2	-2
b to c	3	-1
c to d	4	-2
d to e	5	0
e to f	6	0
f to g	5	-1
g to h	4	-1

The Princess and the Dragon

Mary Parrish and Janice Halley

An interesting game to play with intermediate elementary school children is this variation of the "Hot-Warm-Cold" game. Player #1 picks two numbers from the grid (example shown below). One number is the "princess", the other is the "dragon". Player #2 guesses a number and player #1 tells him whether it is hot, warm, or cold according to its position in relation to his "princess" or "dragon". A number is hot if it is connected by a vertical or horizontal line. A number is warm if it is connected by a point, and a cold number is not connected at all. (See example below.)

If player #2 finds the "princess" he wins and gets to choose the next numbers. If he finds the "dragon" he loses, and player #1 chooses again. This game can be played with two or more children.

Example: If 2 is the "princess" and 13 is the "dragon", then 1, 6, 9, and 8 are hot, 12, 14, 11, and 15 are warm, and all others are cold for the "princess".

For the "dragon", 7, 11, and 10 are hot, 9 and 16 are warm and all others are cold.

12	1	15	3
6	2	8	4
14	9	11	16
5	7	13	10

Money Lotto

Elizabeth Bertels

The second graders I have been working with have been learning to count money. A few of them were having trouble and the teacher asked me to spend some time working with them. They like to play games so I worked up a game I call "Money Lotto."

I made boards with six squares on them. In each square I glued a certain amount of money, such as 3 pennies and one dime; 2 dimes; 1 nickel; 1 dime, 1 nickel and 1 penny; 7 pennies; 3 nickels. Each board has a different amount in the squares. Then I made flash cards with amounts written on them, such as 13¢, 20¢, 5¢, 16¢, 7¢, 15¢. It is played as follows.

Each child is given a board. The flash cards are placed face down on the table. The idea of the game is to cover the board with matching cards. The children take turns drawing a card and checking to see if it matches an amount of money in one of their squares. If it does match they place it on their board. If it does not match they return it face down on the table. The winner is the one who covers his board first.

The children enjoyed the game. They helped each other out sometimes and by helping each other they helped themselves.

A variation: I use the flash cards from the lotto game and put them face down on the table. Each child draws a card and then counts out that amount of money from the change I had lying on the table. The children enjoyed working with the "real" money.

Triple-Dice Special Activity

Nellie Rush

Objective: To provide practice in the basic addition and subtraction facts.

Players: Two or more.

Materials: 1. Twelve discs per player.

2. Two regular dice and one die with the symbols +, +, ±, ±, -, - written on it.

3. One gameboard per player.

Directions: 1. The first player rolls three dice. The operation die determines whether he will add or subract the numbers on the other two dice. If the operation die shows ± he has a choice of either adding or subtracting. After he figures out his answer, he covers that number on his gameboard with a disc. If the number is already covered he loses his turn. If the operation yields a zero the player takes another turn.

2. The next player takes his turn.

3. The game continues until one of the players wins by covering all the numbers on his gameboard.

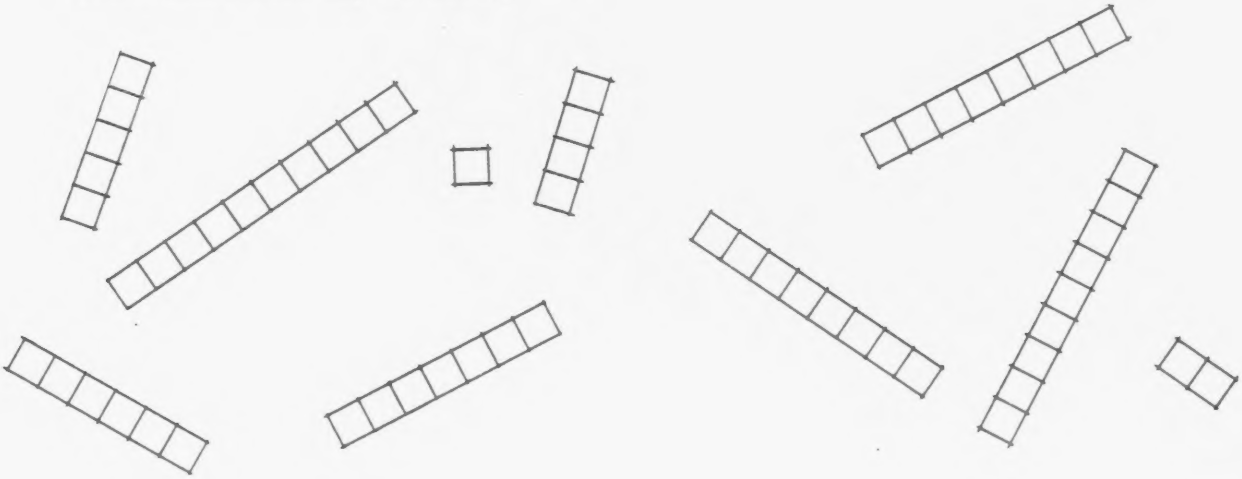
1	2	3
4	5	6
7	8	9
10	11	12

Magic Counters

Helen Jones

Cut rectangles out of squared paper representing the numbers 1-10.

(Cuisenaire rods may be used.)



Using three rectangles make nineteen. How many ways can this be done?

How can this be recorded?

Variation: Use several sets of number rectangles. This can be used to observe children's thinking.

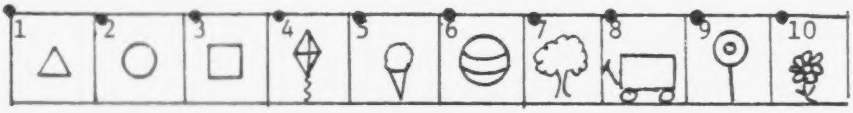
Move and Tell

Lavondas Redmon

This is a fun game that can be used to write mathematical equations for addition and subtraction. The game can be played by one child or a group of children.

Materials: Checker or disc, number line with a picture under each numeral, and a chart to show where each move is to be made.

Rules of the game: You must start at the point indicated. If you move forward on the number line, you must use a + sign to indicate addition. If you start at one point and move backward, you must use a - sign to indicate subtraction.



Start	Go To	How Many Steps?	Write the Equation
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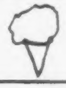	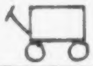		
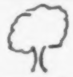	△		

Get Four In A Row

Nellie Rush

Objective: To provide practice in the recognition of numbers and basic addition and subtraction.

Number of Players: Two players.

Materials:
1. Two sets of twelve colored counters.
2. One die.
3. One gameboard.

Directions:
1. Numbers are written at random from 1-6 on the gameboard.
2. Each player uses one set of twelve colored counters.
3. Players take turns rolling the die, and placing their counters on the number they roll on the gameboard. If the number rolled is covered with a counter a turn is missed. The winner is the player to get four counters in a line, diagonally, horizontally or vertically.

Variations:
1. Players may use different colored crayons or X's or O's.
2. Each player may use a separate gameboard and thirty counters. The first player to cover his gameboard is the winner.
3. The game may also be played by leaving the squares blank. Roll the die and write the number in the square indicated on the die. Use colored crayons.
4. Adjust the gameboard for addition and subtraction by writing numbers randomly 1-12. Use one pair of dice. The players add or subtract then place their counters on the sum or difference depending on the operation used. Again, each player may use a separate gameboard with 30 counters.

6	5	4	3	2	1
1	2	3	4	5	6
2	3	4	5	6	1
3	4	5	6	1	2
4	5	6	1	2	3
5	4	3	2	1	6

Writers, Artists, and Philosophers: Thought and Action In A Primary School Classroom*

Michael Armstrong

. . . Most of the work I want to present was a product of moments of intellectual absorption, times at which children were keenly devoted, intellectually and emotionally, to the task in hand. I'm not necessarily thinking of those occasions when children were "working hard" in traditional terms; absorption in a task is often playful as well as hard work, relaxed as well as tense, sometimes even noisy. It's the sincerity and not the solemnity of the occasion that matters.

Obviously, productive learning is not restricted to such moments of absorption, but they are, or can become, commonplace - even in schools - and they are of critical importance both for the course of learning and for thinking about the course of learning. They are important for three main reasons. The first reason is that in their moments of absorption children reveal most about themselves and about the character of their thought. It is fashionable in certain circles to regard our unguarded moments as the most revealing. I don't share that fashion. I think that it's the moments when people are most serious, whether or not they're being frivolous at the same time, that tell us most about them. The second reason is that it's in their moments of absorption that children best demonstrate their own intellectual competence, and, further, it is only through a succession of such moments, along with other less intense passages of learning, that intellectual growth can be sustained. The third reason is that in their moments of absorption children do more than absorb knowledge; they recreate it.

I'd like to allow myself here a single polemical remark about the present state of educational debate, at least in England. It seems to me that the one great divide in education is between different conceptions of children's creative and critical powers. There is a long-standing tradition that childhood is essentially a *pre*-creative and *pre*-critical stage. The English philosopher Michael Oakeshott once described school education as "learning to speak before one has anything significant to say." ... That's a neat, if somewhat extravagent, summary of a view of education which is still prevalent in England, and I daresay in the United States, too. According to this view, education, at school level at any rate, is concerned with developing the basic competence that is a *precondition* of creative and critical thought, rather than with providing opportunities for the *practice* of creative and critical thought. It's only *after* children have acquired this basic competence that they are *able* to be creative or critical. Hence, in part, the current fashion to return to what in England we call the three R's, to "get back to basics."

To some of us this tradition seems self-defeating; experience and reflection alike suggest to us that the growth of competence itself depends upon a process of creative and critical thinking; that children become competent through a continual engagement, at once critical and creative, with the world around them, the world of everyday, of people, and of things, and the world of knowledge, including the most complex forms of knowledge. Without that engagement intellectual competence is largely unattainable. . .

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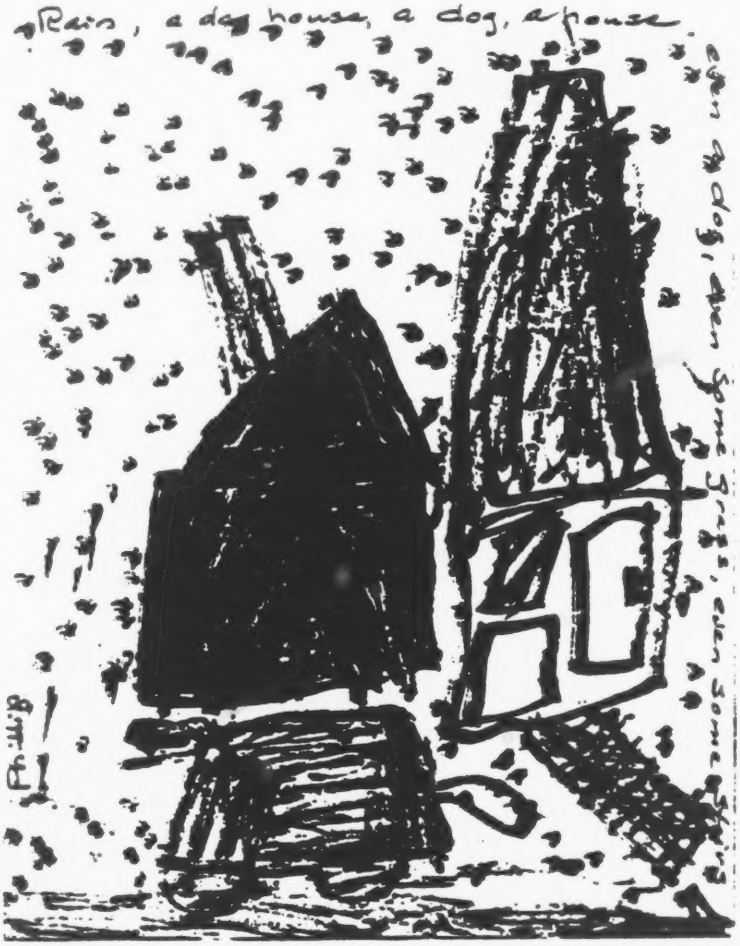
Two Interesting Problems

Sue Modro

I. Oscar offered to take out the garbage every day during the month of December, providing his parents pay him a penny the first day and double his pay each day. Is this a good deal for Oscar's parents? How much would he earn at the end of the month?

II. Recently, the pole used by the daring Wallenda's in their high wire circus act was cut into one inch sections and sold for $17.50 each. If the pole was 23 feet long, how much money was raised for the Circus Retirement Shelter? If the Circus Retirement Shelter wanted to break the million dollar mark, how long would the pole need to be?


Rain, a dog house, a dog, a house
even a dog, then some grass, even some stairs
Phillip

Phillip Martin

More On Shapes

Helen L. Miller

As I was preparing several items for various Christmas projects for my kindergarten classes, I discovered another method a teacher might use to familiarize children four and five years old with shapes. This method can also be used as a way of enabling the children to observe for themselves the relationships between right angles, right triangles, squares, rectangles, etc.

I took the cheapest plastic sponges and cut them into right triangles, squares, rectangles, circles, all about the same size.

Each child was allowed to use red or green tempera paint (Christmas colors). They were to dip the sponges into the colors and design wrapping paper for gifts they had made for their parents.

It was very messy at first and then some of the children discovered how to make a square using two right triangles; some of the children put other shapes together to see what they could create. It got to be a challenge to see what "new" shapes they could discover.

It was fun to watch the "wheels-go-around" as each child made his/her own discovery.

The Teaching of Young Children, Some Applications of Piaget's Learning Theory, Edited by Molly Brearley

A Book Review by Diane Savoca

> "The role of a teacher is a complex one and no sterotype will fit it. Each teacher virtually builds his own role and there should be scope for each to play his part and for that part to be, in itself, a developing one." (p. 184).

This quote sets the mood for this "little" book with "big" ideas. It is a psychology book, a philosophy book, a learning theory book, a teachers' activities handbook and even more. Ms. Brearley applies Piaget's learning theory to science, art, literature, movement, mathematics, music and morality education. The applications in some places are confusing but in most cases they are enlightening. In all cases she emphasizes the uniqueness of each student and each teacher.

Ms. Brearley believes that human minds are constructed as a result of interaction with other humans, their environment and interaction between inner experiences. She views Piaget's theories as aids in understanding a child's mental processes. When children participate in searching and sharing knowledge with their peers and teachers, their mental processes will be self-expanding and continously growing. It is to this end that teachers must teach. "The role of the adult in the classroom is three-fold: it is the role of provider of material and stimuli as well as of a 'climate' which allows for individual and social growth, of a mediator of experience who looks on every aspect of children's living as a means of learning and of a teacher, whose professional knowledge and skills enables her to teach at the moment of willingness and ability to learn." (p. 184).

Notice she is not telling us how to teach. That is left up to our unique selves. What she is doing is presenting a strong directed philostion." (p. 28).

On The Images Of Artistic Expression:

".... we cannot strictly have the same experiences as others, for experiences are basically a personal matter. This is why images are essentially symbolic representations. They are not replications, but symbols of experiences through which we have lived and learned." (p. 40).

On The Development Of Artistic Standards:

"If children have something to express which they feel is worth expressing, time in which to express it and the materials with which to do so adequately, then the conditions have been provided for the development of standards." (p. 50).

On The Function of Art:

"A work of art has a function in extending human experience." (p. 50).

On Reading:

"Reading is an extension of language development. Language is grounded in and develops out of personal experience, enabling an individual to codify, clarify and extend his understanding of objects, situations and relationships. Reading performs the same function, but provides much greater opportunities, by making available to one person the cumulative thought of others." (p. 60).

"What he reads must have a meaning to him: the mere reading of 'words' lacks any purpose, as it can be a mechanical skill having no effect on his intellectual and emotional life." (p. 61).

On Movement:

"Children have a natural appetite for movement and need to move as they need to eat and sleep." (p. 73).

"Just as all movement takes place in space, so all movement has an expressive nature."

"All children move. It is our job to help them to raise this activity to a higher conscious level." (p. 82).

"The relatedness of movement and intellectual development may be appreciated in the ways in which a child's body comes into contact with the environment in an active way and through which he is able to judge depths, heights, distances and lengths." (p. 84).

ophy of education. She offers an answer to "What's it all about?" This book is a must for all dedicated teachers especially those who work in early childhood and primary education.

Here are a few more of Brearley's pearls to ponder:

On Building Confidence:

> "What children have already learnt must be built on and appreciated if they are to begin to get a glimpse of their own learning powers and build up confidence in them." (p. 3).

On The Purpose of School:

> "The main work of the school is surely the fostering and developing of mental life, enabling children to experience more fully and consciously all that life has to offer. This large overall aim is to be achieved by an infinity of small steps. The material we provide can seldom be thought of as an end in itself but rather as a means through which effective thinking and feeling are fostered." (p. 7).

On The "Feeling" Side of Life:

> "The 'feeling' side of our mental life equally needs cultivation: means of communication through language and the arts provide for the expression, use and control of feeling and response." (p. 8).

On The Teacher's Knowledge:

> "It is important that the continued study by the teacher in order to keep his own knowledge up to date and to preserve his own satisfaction in learning should be regarded as an essential ingredient of 'modern methods'." (p. 15).

On Learning:

> "Human learning is a process of building up an internal model of the world." (p. 17).
>
> "Learning is accelerated and structured in a logical hierarchy if the material to be studied is presented in a heuristic way and with students adequately prepared." (p. 28).

On Experiments:

> " .... an experiment is an artificial device for putting the observer in a favourable position with respect to nature: a contrivance to arrange events where they can be seen." (p. 28).

On Observation:

> ".... a skill born of interest, training, practice and evalua-

On Mathematics:

> "Mathematical concepts are constructed from the mathematical abstractions and generalizations which children make from their own actions on objects and situations." (p. 95).
>
> "A teacher has a dual responsibility in the development of mathematical concepts, first in creating the basic environment within which the learning can take place, and second by intervening in children's learning, when appropriate, to help them focus on the relevant mathematical elements. Throughout this book the role of language in clarifying, refining and extending children's ideas is emphasized, and it is crucial in helping children to focus their thoughts on mathematical relationships." (p. 97).

On Music:

> "We know that enforced listening causes ears and minds to be shut and becomes not listening at all, doing little to reccommend listening to music." (p. 128).
>
> "The teacher is presented with the problem of creating a situation in which children are free to explore and discover and experiment for themselves with musical things, and one in which they are free to make up their own music in the mode of working appropriate to their stage of development." (p. 128).
>
> "It must, too, be a situation in which they are free not to make up music if their present interest lies elsewhere." (p. 128).

On Morality:

> "Thus moral development consists in part in the growing ability to put the common good before the selfish one, to live by moral principles of justice, loyalty, integrity, responsibility and respect for persons, which transcend personal gain." (p. 139).
>
> "Moral development consists in learning what ought to be done as well as what ought not to be done, and it is partly by having desirable behavior acknowledged and valued, and where possible the reason given for valuing such behaviour, that this learning takes place." (p. 153).

On Self Concepts:

> ".... if children are helped to become consciously aware not only of what they are learning but also of how they are learning and what can be done with that knowledge, then, later by adolescence they will have formed 'self' concepts which will enable them to use the many aspects of themselves with enjoyment and skill in pursuit of individual and social ideals." (p. 169).

Boo!

(A game for little bitty kids)

Helen Miller

Once upon a time there was a very mean little ghost named Max and he had a friend named Sam. At Halloween Max and Sam found all kinds of mischievous things to do. The thing they liked to do best was to steal jack-o-lanterns and hide them behind the bushes.

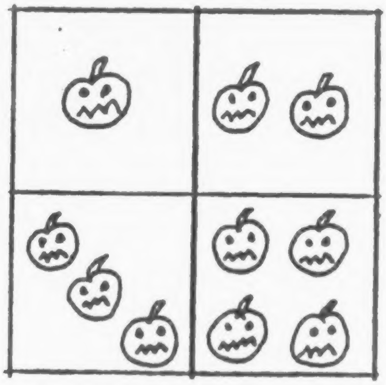
They always returned them, but it was a bother to go hunting all the jack-o-lanterns on Halloween night.

When you play this game you will see how many jack-o-lanterns Max and Sam hide behind the bushes.

Use one marker for Sam and one for Max and put each one of them on one of the squares. Count the dots to see how many jack-o-lanterns they hide.

Where can you put Max and Sam so they will have the fewest jack-o-lanters to hide? Where will they be when they have the most to hide? How many different amounts of jack-o-lanters can they find to hide?

Can you find another game they can play?



Child's Play Is Called A Serious Business*

Fred M. Hechinger

The tedium is the message of many modern educational toys, games and children's television programs, tediously intent on serving a solemn purpose of rushing the children's development.

Much of this, some pedagogic experts say, flies in the face of what has long been known about children's play. Plato, in "The Republic," warned parents to "avoid compulsion and let early education be a manner of amusement. Young children learn by games; compulsory education cannot remain in the soul."

More recently, the late Jean Piaget wrote on the same theme: "Every time we teach a child something, we keep him from inventing it himself. On the other hand, that which we allow him to discover for himself will remain with him."

These age-old lessons, say Maria W. Piers and Genevieve Millet Landau, have been forgotten by too many parents who consider a child's play a waste of time. Dr. Piers is Distinguished Service Professor and former Dean of the Erikson Institute for Early Education in Chicago. Mrs. Landau, former editor of Parents magazine, is director of the Hasbro Center for Child Development in New York.

Anxious to give their preschool children a leg up on the competition for success in school, college and life, many parents put pressure on nursery schools to teach children to read, memorize, do formal arithmetic and play games designed to reinforce those skills.

"The assumption that children at play are not learning anything valuable - not developing or being prepared for school and life - is distressingly widespread. It couldn't be more wrong," said Dr. Piers and Mrs. Landau.

The two experts in child development last year presented their own and other authorities' views to the first National Conference on Play. They have expanded their report into a book, "The Gift of Play," which will be published next week (Walker & Company; $9.95).

"In trying to define child's play," they comment, "educators often say that play is the child's work. But this description, unfortunately, has led some parents and teachers to value only that play which seems to them really serious."

What adults often aim for when supervising or directing children's play is the kind that seems to them to teach the virtues of adult life, such as persistence, prudence and ambition. This is rarely what children have in mind when they spontaneously design their own play.

Regrettably, the importance of the "message" has also invaded children's television. Earlier this month, for example, a new episode of "The Flintstones," a favorite children's cartoon, had a hotly contested baseball game end in a tie, followed by celebrations of brotherly and sisterly love - hardly the real aim in any normal child's view of competitive games.

Self-motivated play that allows children to discover themselves and the world around them, many experts believe, is vital to healthy development. Yet, striving and pushing adults deprive children of that opportunity. Success-oriented lessons to prepare children for school replace real child's play, which, at the heart of the Piers-Landau thesis, is seen as the "surest, fastest path to learning, self-confidence and mastery of many skills."

A look at the animal world shows that play is crucial in the development of the young of all intelligent species, and the higher the animal's level, the more prolonged the play phase and the more varied the games. Thus, for instance, little chicks don't play; but kittens and puppies do, thus acquiring many of the skills they need to survive.

Babies and infants play at everything they do, starting with playful sucking at the mother's breast or at the bottle. When being playfully cuddled, a baby develops what Erik Erikson calls "basic trust," or the predominance of trust over mistrust. Infants play at mealtime, in the bath and with all objects around them.

"The remarkable aspect of learning through play," said Dr. Piers, "is that it is never lost. Later lessons acquired in school are forgotten, but the things we learn in play - hard but playfully won - we never forget."

Occasionally, parents are concerned when a child, after a painful experience in the hospital, keeps playing "operation" over and over. The experts say that this is a natural way of getting over shock or unpleasant memories, just as an adult may be trying to do by telling the minute details of a recent operation to everyone who wants to listen. Play can be therapeutic.

Jerome Bruner, the child psychologist, has pointed to the playful way children, at about age 3, often amuse themselves by talking out loud to themselves, playing with words and sentences. This should not be viewed, said Mrs. Landau, as a signal to replace such constructive but spontaneous display with formal instruction that often gets in the way of exciting discovery.

Slowly, by the time children are 4 years old, their games take on shape and purpose, with a beginning, a middle and an end. Their playing reflects an order that, in turn, reflects the children's observation of the world around them. What may seem boring and repetitive to adults gives children security.

This defense of freewheeling play is not a plea for chaos. The child's day, at home and in nursery school, requires structure and reassuring predictability of scheduled activities so that the child knows what to expect.

But within this structure, children should be allowed to give rein to their imagination. Active play, including vigorous outdoor activity, should be encouraged, but daydreaming and pretending should not be frowned upon or impeded.

"There is no merit, and considerable damage," in the Piers-Landau view of childhood, "in including in the (nursery school) curriculum lesson-games designed to teach children reading skills and abstract mathematical concepts."

Albert Einstein once mused: "When I examine myself and my methods of thought, I come to the conclusion that the gift of fantasy has meant more to me than any talent for abstract, positive thinking."

These views are controversial. They fly in the face of some success-oriented middle-class ways and what is often described as the Protestant work ethic. But the advocates of an unhurried, playful early childhood are not arguing against either success or work. They are saying that self-started play, supported by warm expressions of adult love, is part of the ladder to successful development. It is the child's equivalent of work. The very use of the term "child's play" to signify something absurdly easy shows a misunderstanding of how serious play is to children.

*This article is reprinted in its entirety from the October 21, 1980 New York Times. Reprinted by permission.

Math Bingo

Marcella DiPaolo

Pass out a piece of typing paper to each child. Separate the sheet into 45 squares (9 across and 5 down). The first column is for multiples of 1, second column—multiples of 2, third column--multiples of 3, ... ninth column—multiples of 9. The child writes appropriate multiples in the squares. He/she might choose ones that give him/her the most trouble or the ones that give him/her a better chance of winning.

The caller prepares a square for each of the multiplication facts 1 through 9. The game begins with the caller pulling a square out of a box and reading it (ex. 6 x 3). The children may use an 18 in either of 3 multiples or 6 multiples. The game follows regular Bingo rules.

1	2	3	4	5	6	7	8	9
3	4	18	16	30	24	42	8	18
6	8	6	32	10	12	35	24	63
8	10	12	20	15	18	49	16	81
9	6	15	12	20	30	28	32	36
7	12	9	8	40	36	21	64	54

A variation on this multiplication Bingo is to pull just the "answers" (i.e. 35, 48, 12) from a box and children write the number in a grid like this:

x	1	2	3	4	5	6	7	8	9
1									
2									
3									
.									
.									
9									

First player to complete a row or column is the winner.

The Best Way to Learn is to Live

proverb by Teddy O'Neill*

Mary Steffen

Not so very long ago Bob Jeffery from England was here to "bend" with us. During his stay, Helen and I shared a book called "The Geranium on the Window Sill Just Died But Teacher You Went Right On." In response, he sent a copy of "The Idiot Teacher" by Gerald Holmes. We found this book about Teddy O'Neill's struggles to make his Prestolee School a place to learn by living very encouraging and wanted to share with you a few quotes. If you should want more, the book is still in print in England. A helpful bookstore like Paul's can get a copy for you.

The teaching of 'subjects' has, of course, usurped the time which might have been devoted to 'Educating'. The Ministry of Education has proved to be a Ministry of Subject Teaching. It has organized the training not of Educators but of subject-teachers. The driving force behind all this resulting activity is the passing of exams in the subjects taught. This passing of examinations in selected subjects is no training for disciplined communal life.

Even the technique adopted is unfortunate from this point of view. In forcing the child to compete with his class-mates for prizes and other marks of distinction, teachers have tempted him to regard his comrades as rivals and possible enemies: to pride himself on his petty achievements and to look down on those he may happen to surpass. They have exploited his selfishness, his ambition, and his vanity. By making him over-dependent on themselves for instruction and guidance they have tended to paralyse his faith in himself.

Can a better use be made of these formative years?

As this question is often in the air, it seems that the time is not inappropriate for telling the story of one man who, during the past thirty years, has patiently and courageously brought into being a school in which children are able to develop their innate characteristics - truthfulness, trustfulness, helpfulness, discovery, activity, initiative, concentration, gregariousness - and grow into well-informed, conscientious, resourceful companions - sensitive to Goodness and Beauty as well as to Truth - and healthily disciplined, in that it comes naturally to them to act together for a purpose when - as is so constantly the case - well-balanced, disciplined action is the very essence of civilized life.

Teddy O'Neill told of how he asked of child and teacher the development of the sense of responsibility: how each child was encouraged to have his own, self-imposed programme of work and expected to feel in duty to himself bound to carry out this scheme. 'You can only teach a child to live by allowing him to live: to be a responsible person by allowing him to take responsibility: not to steal by allowing real opportunities to refrain from stealing: not to misuse tools by giving opportunity for their use. Even a dictionary and a Bible can be misused by filthy minds, but are they therefore to be put away? There must be freedom in the school, but there must also be a directive environment, spiritual and material. Just as life does - so should the school environment disclose to us the necessity for work.'

Here are some of Teddy's proverbs. He used some with his teachers, others were sprinkled around for everyone.

FANCY TEACHING MONKEYS HOW TO CLIMB!
GIVE CHILDREN OPPORTUNITIES TO TAKE RISKS AND LEAVE THEM TO DO IT

CHILDREN ARE ONLY 'LITTLE DEVILS' WHEN THEY CANNOT FIND SOMETHING LEGITIMATE TO DO.
THE LIFE FORCE IS THERE.
DO SOMETHING THEY MUST,
OR ELSE THEY WILL BUST

THE PASSING OF EXAMS IS NOT EDUCATION
ASK HIM SOMETHING WHICH HE DOES NOT KNOW, AND SEE IF HE CAN FIND OUT

MANY TEACHERS DIE IN SCHOOL BUT ARE NOT BURIED TILL LATER

THE 'ACID TEST' IS LIFE AND CHARACTER--NOT SUBJECT KNOWLEDGE AND EXAM RESULTS

SIMULTANEOUS WORK MEANS THE SUPPRESSION OF INDIVIDUALITY

SIMULTANEOUS WORK MEANS THE SUPPRESSION OF INITIATIVE

AREN'T MEN AWFUL?
THEY SHOULD MAKE THINGS BEAUTIFUL, NOT BEASTLY.

CHILDREN SHOULD BE ALLOWED TO WORK WITHOUT CLOSE SUPERVISION, OTHERWISE THEY WILL DO NO WORK WITHOUT IT

THE MEN WHO MATTER ARE THOSE WHO DO MOST OF THEIR THINKING AND DOING THEMSELVES

THE BEST WAY TO LEARN IS TO LIVE

PROGRESS IS DUE TO THOSE WHO DO WHAT OTHERS DON'T DO

'IMPOSSIBLE' IS THE SLOGAN OF A FOOL

SELF-ACTIVITY IS THE HABIT OF STARTING WORK WITHOUT BEING TOLD TO

IT IS GEESE THAT NEED STUFFING--NOT CHILDREN

DON'T BE A DEAD DUCK STUFFED WITH SAGE AND ONIONS BY THE COOK OR WITH 'SUBJECTS' BY THE TEACHER

REAL POVERTY IS LACK OF IMAGINATION

CARS ARE SO WONDERFUL THAT MEN CAN DRIVE THEM. MEN ARE EVEN MORE WONDERFUL FOR--UNLIKE CARS--THEY CAN DRIVE THEMSELVES

EDUCATE FOR DIFFERENCES

UNIFORMITY IS DEATH TO CHARACTER

*Reprinted with permission from Russell Press Ltd., Nottingham.

Now, Psychological Man*

Angus Campbell

In his State of the Union Message in 1970, Richard M. Nixon observed: "In the next 10 years we will increase our wealth by 50 percent. The profound question is, Does this mean that we will be 50 percent richer in any real sense, 50 percent better off, 50 percent happier?" Now, 10 years later, it is clear that he overestimated the nation's economic growth but his "profound question" still remains: Does increasing affluence mean a greater sense of public well-being?

For the last 100 years, we have had a prevailing faith in the power of economic prosperity to elevate the good life. It would be hard to argue that over that century of increasing affluence, the life of the average American has not been enhanced. Small wonder that the gross national product and other economic indicators have, as a publication of the old Department of Health, Education and Welfare put it, "become so much a part of out thinking that we tend to equate a rising national income with national well-being."

Sometime during the 30 years following World War II, however, something went wrong with this simple tie between economic welfare and the public sense of well-being. Americans experienced one of the most dazzling rises in economic affluence in the nation's history. Average family income went up by about two-thirds in constant dollars between 1945 and 1973, a remarkable national achievement. But, as we increased the ability of our people to purchase the material things of life, we also experienced a great increase in divorce, illegitimacy, juvenile delinquency, suicide, a growing fear of criminal assault, the development of a widespread drug culture, the alienation of a sizable number of young people, a spreading spirit of cynicism and distrust of government, and a general malaise regarding the state of the nation. National surveys demonstrate that as economic welfare increased during the postwar period, psychological well-being declined, especially among the young, the affluent, and the well-educated.

Many factors contributed to this turn of events, not the least of which appears to be inherent in the nature of affluence itself. Public aspirations and values can no longer be as readily satisfied by simple increases in economic affluence as they may have been earlier in our history. There appear to be a growing number of people for whom economic circumstances are no longer the pre-eminent determiner of a sense of well-being. Economic man is being superseded by psychological man - people for whom what Abraham Maslow, the late psychologist and philosopher, called "higher needs" have become important. This conclusion is supported by studies in Scandinavia, the Common Market, Canada and this country that find income to be losing its relationship to the way people describe the psychological quality of their lives.

This decline in the significance of income occurs primarily among the more advantaged parts of the population and it does not mean that people have lost interest in having the material things and other benefits that income makes possible.

What appears to have happened is that an increasing number of people have achieved a degree of economic security that has liberated them from an obsessive concern with income, with a consequent increase in the importance of nonmaterial needs - the need for a sensitive and responsive marital relationship, for challenging and significant work, for the respect and approval of friends, for identification with community, and for a stimulating and fulfilling life.

Senator Daniel Patrick Moynihan once observed that governments seldom do anything about a problem until they have learned to count it. Governments have well-established ways of responding to public needs for a minimum income, adequate housing, and medical care. But they have a more difficult time with such subjective states as alienation, boredom, job dissatisfaction fear of crime, loneliness, resentment of descrimination, loss of confidence in authority, and other conditions that diminish the psychological quality of people's lives. They do not have a clear sense of how widespread these problems are or a sure feeling of how to deal with them.

At present, inflation and unemployment are creating economic stress for many Americans, and our government officals are understandably obsessed with these problems. Eventually, however, the national agenda will have to give greater prominence to the psychological needs of the population than it has in the past.

We must recognize that people may be deprived psychologically as well as economically. As economic needs are met, psychological needs assume priority.

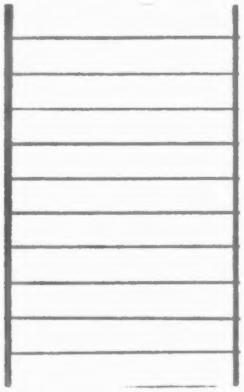
A government that aspires to raise the national quality of life must concern itself with both.

*This article is reprinted in its entirety from the October 31, 1980 New York Times. Reprinted by permission.

Bends on Tens Patience

Shirley Casey

Seedbed 7 contained an article on Bob Jeffery's game of Tens Patience. It involved drawing ten numbers (from a set of 100) and placing them (looking only at one at a time) on a ladder



so that the numbers end up in order from bottom to top.

Discussions at the Belleville Area Teachers' Center have helped us to see that this technique can be used for anything that requires ordering.

For example:

Use a five-rung ladder and write the days of the week on the cards.

Use a seven- or eight-rung ladder and write the months on the cards.

Use a ten or twelve rung ladder and write the letters of the alphabet on the cards.

To put a group of words in alphabetical order (for example a list of spelling or vocabulary words) use a ladder with about half as many rungs as there are words to be alphabetized.

Estimating *

1. How many kernels of corn on an ear? (It's fun to count them ... but the rows are not always straight.)

   630 kernels on one ear. (Approximately)

2. How many kernels of corn in a can? (It's not fun to count them ... so why not count to 1/4 cup full and multiply?)

   1500 kernels in one 12 ounce can. (Approximately)

3. Is it cheaper to buy corn on the cob or corn in the can? In the summer or winter?

4. What about name brands of corn vs. off brands?

5. Have the students estimate the number of squares in a roll of toilet paper.

   How many squares are there? How many squares for the length, width and perimeter of the room?

6. What is the area covered by paper towel squares if laid on the floor?

   Is there an easier way to figure out the area than covering the floor with paper?

   What is the cost per square?

7. How many kings are in King Vitamins?

8. How many yellow moons, pink heart and green clovers are in Lucky Charms?

   Are you paying for marshmallows or cereal?

In this day of inflation and rising food prices, mathematics and good logic can help to create interest in the economics of home management.

*Oops. This article came from a Teachers' Center participant, but the author's name is unknown to us.

Rainbow Squares

Diane Savoca

The purpose of the rainbow squares is to develop creative or divergent thinking. The students are given the opportunity to discover the relationships of numbers and the basic mathematical processes. They consider the possible alternatives and come to a conclusion. The level of difficulty increases from elementary in Activity #1 to complex in Activity #5. The last activity deals with using the squares in language development. The basic idea behind all the activities is color representation, however, the "color-number" or "color-letter" code should change in each activity so that the student does not conclude that one color always represents the same number.

Materials: These activities were designed to be used with Unifix Cubes*, but they are not necessary. You may use a felt board with felt squares of ten different colors and eleven white triangles marked with numbers, 0-10.

Activity #1

Select one triangle and two squares that are the same color. Show the student and say, "If you were adding what would these numbers be?" "The squares are the same color so they are the same number." See Figure 1.

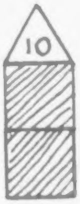


Figure 1

Activity #2

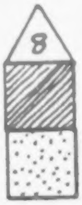


Figure 2

Select one triangle and two different colored squares. Show the student and say, "If you were adding what would these numbers be?" You may proceed to, "What would these numbers be if you were subtracting?" ...multiplying?" What if it was an improper fraction?" See Figure 2.

Activity #3

Use two triangles, i.e., 23, 46, 92, on top of several squares. Say, "If you were adding what would these numbers be?" You can make it as easy or difficult as you like. See Figure 3.

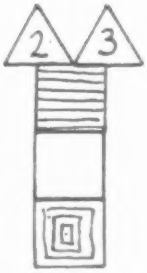


Figure 3

Activity #4

Use two triangles or more on top. Arrange the squares as in Figure 4 or any other variation you may desire. When two squares are together it means multiply; when there is a space it means add.

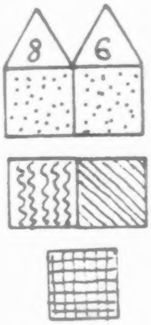


Figure 4

Activity #5

Use the same idea as above, only spaces mean add or subtract and squares together mean multiply or divide. Try the problem in Figure 5. How many solutions can you find?

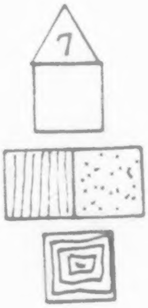
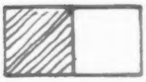
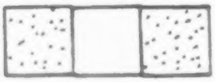


Figure 5

Note: For 8th-12th graders it would be interesting to provide triangles with negative numbers.

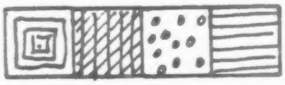
Activity #6

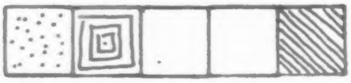
The rainbow squares can also be used in a word game where the color squares represent letters.

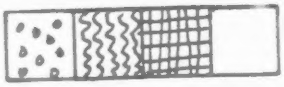
Can you guess what these words are?  

You can play with just isolated words or give contexts.

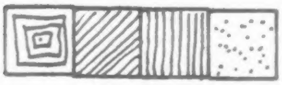
For example:

This is a popular song. 

I am very  you are staying.

I went to the store yesterday and bought  .

Three dogs were chasing me across the yard and I yelled,

 .

There are unlimited variations of this educational tool; your imagination is the limit.

A Maverick Teacher Enlivens Students With Flair and Style *

Fred M. Hechinger

Heartwarming school storeis usually start with fond memories of an indelible impression made by an elementary school teacher. John A. Rassias, the maverick professor of romance languages at Dartmouth College, recalls such an indelible impression, which, though less than heartwarming, helped shape his dogged determination to reform teaching.

The unforgettable character was a Miss Lambert, the fourth-grade teacher who introduced him to the mysteries of "conversational French" and for two weeks belabored the intricacies of vowels and consonants as they emerge from the odd physiognomy of French tongues, lips and throats. John's tenure in beginner's French came to an abrupt end when he bit off the pencil Miss Lamber had pushed down his throat in order to produce the perfect French r.

Even before the French debacle, Miss Lambert had made an impression. After a less than virtuoso performance by a visiting Works Progress Administration orchestra during the Depression, she had informed the inquisitive youngster that the conductor had been superb because he was "dignified, rigid and well dressed."

Several years later, clutching a free pass to Carnegie Hall, young John Rassias had his first introduction to a real orchestra. By Miss Lambert's yardstick, the conductor, dressed in an ill-fitting tuxedo and frantically waving his baton with nonrigid lack of dignity, would never qualify. His name was Arturo Toscanini.

Last week, Professor Rassias recalled Miss Lambert's impact on his career as he addressed the annual conference of Pennsylvania's modern language association at Chatham College. He is best known for his unconventional foreign language instruction (described in this column earlier this year), including his success in teaching "street Spanish" and Latin culture to 30 New York City police officers in a two-week crash course at Dartmouth, a project soon to be extended to greater numbers of the force.

At the heart of his lecture was more than a compelling appeal to rescue modern language teaching from its doldrums; the gist of his message was aimed at teaching any subject.

He addressed the age-old question of what constitutes effective teaching beyond the teacher's essential mastery of the subject. Professor Rassias condensed his prescription into "five principles of teaching," which are controversial, debatable, idiosyncratic, but undeniably pulsating and alive. They can, and will, be contested and criticized, but in the hands of a dedicated master they are difficult to ignore.

Here, the "principles" are summarized, regrettably without the visual benefit of what has come to be known as "the Rassias method":

1. Self-knowledge. For the teacher, this means to look back on his or her own experience as a pupil and "to get rid of the things that turned us off." It calls for an understanding "that we are shaped by what we teach." It means making the pupil sense that the teacher is the same person, with the same values, in class and out.

2. Direction. In the official jargon, Professor Rassias says, this translates into a "lesson plan." But in effective teaching, he adds, it is not "that plodding, lifeless requirement" which must be handed into the principal or the department chairman; it is the teacher's knowledge of his role and goal "because he is an actor in a drama." It is being prepared for anything that may develop and using it to move toward the ultimate goal.

3. Spontaneity. Students, Professor Rassias says, really expect the teacher to do something, not just to transmit what is in the textbook. When he wanted to demonstrate to the police officers that "language is a matter

he wanted to demonstrate to the police officers that "language is a matter of life and death," he blindfolded one of them and had the others guide him, by spoken instructions only, through a made of dangerous obstacles. Part of spontaneity, he says, is "creating the illusion of the first time" in experiences that require a response from the learners. "We must never assume," he warns, "that our students have no imagination."

4. Stage presence. This principle, Professor Rassias says, applies not only to the actor-teacher but to students as well. It requires making everybody in the class feel that "he is a star in his own right." It can't happen, he underscores, "if we shoot children down" when what they do is, in Miss Lambert's words, not perfect.

A teacher, he says, should be ready to hug and praise a youngster who has made a brave stab at a new problem. Chances are that by the end of the week he'll get it right if the teacher doesn't frighten him out of trying. What matters first and foremost, Professor Rassias insists, is that the teacher genuinely respect the pupils as human beings.

5. The creative state. The teacher, says Professor Rassias, must face the class intent on creating and sharing experiences. Some critics, he concedes, consider his action-oriented approach less than intellectual. "Wrong," he replies. "The point is to make the student remember the experience," and he is most likely to remember when his emotions and intellect are engaged.

After all, he himself remembered Miss Lambert's lesson because his emotions were involved, however negatively. But, he asks, what will the students whom he watched in an English class on the Gold Coast of Africa remember of the lesson in which the teacher read ponderously:" "Hark! he said dolefully ..." "When," asks Professor Rassias, "have you ever heard anyone say, 'hark'?"

Initially, Professor Rassias admits, children may be shocked "because

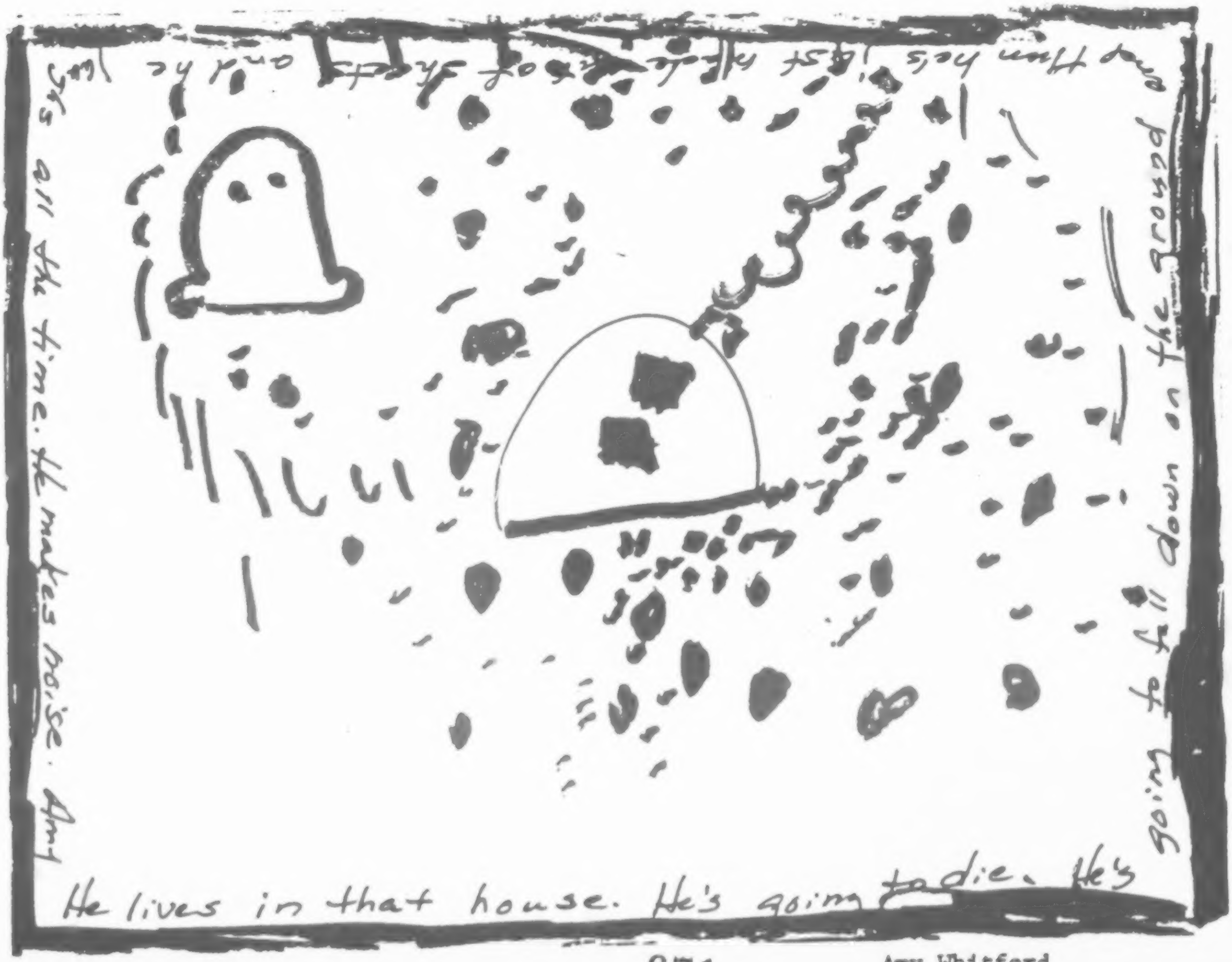
I'm actually moving, touching, acting." The question, he adds, is always what happens next. The class looks forward, wants to know. The battle of effective teaching is on the way to being won.

"How do you survive the day?" the question came at John Rassias from the audience, as he stood disheveled, sweating, his shirt literally in shreds.

"I draw strength from the students," he said. "Each class is different and new. It revives me."

He leaves no doubt that he thinks it is better for a teacher to die of exhaustion than of boredom.

*This article is reprinted in its entirety from the October 14, 1980 New York Times. Reprinted by permission.


He lives in that house. He's going to die. He's
going to fall down on the ground
and then he's just a [illegible] of sheets and he
laughs all the time. He makes noise. Amy

Amy Whitford

Teaching With Beads

Esta E. Johnson

Dr. O'Brien introduced this idea of using different colored beads to teach words to children.

Ex. ● = yellow bead ○ = red bead ⊕ = blue bead

○●○ = dad ●○● = wow ●⊕○○ = free ●⊕⊕○ = good

I tried this activity with my language students - grades 3 through 6 - and they really enjoyed it!

In class, however, we went a little further with the activity. Children spelled their names in colors. Can you tell who this is: RYBBG? RYR?

I also used the beads for punctuation. Suppose a yellow bead represents a question mark and a red bead represents a period. I read out a sentence and the students would have to hold up the bead they thought was the correct one.

Ex. Did you see him yesterday (yellow bead)

He went roller skating with Alex (red bead)

Another idea is to use blue beads for words and red and yellow for punctuation. What possible sentences are there?

Ex. BBBBBR (She went to the store.)

BBBBY (Where is the dog?)

Although the Teachers' Center is primarily for helping teachers with math, I was very glad to see this particular lesson introduced. It was useful to me since I am an Oral Language teacher.

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Edwardsville, Illinois

Angus Campbell
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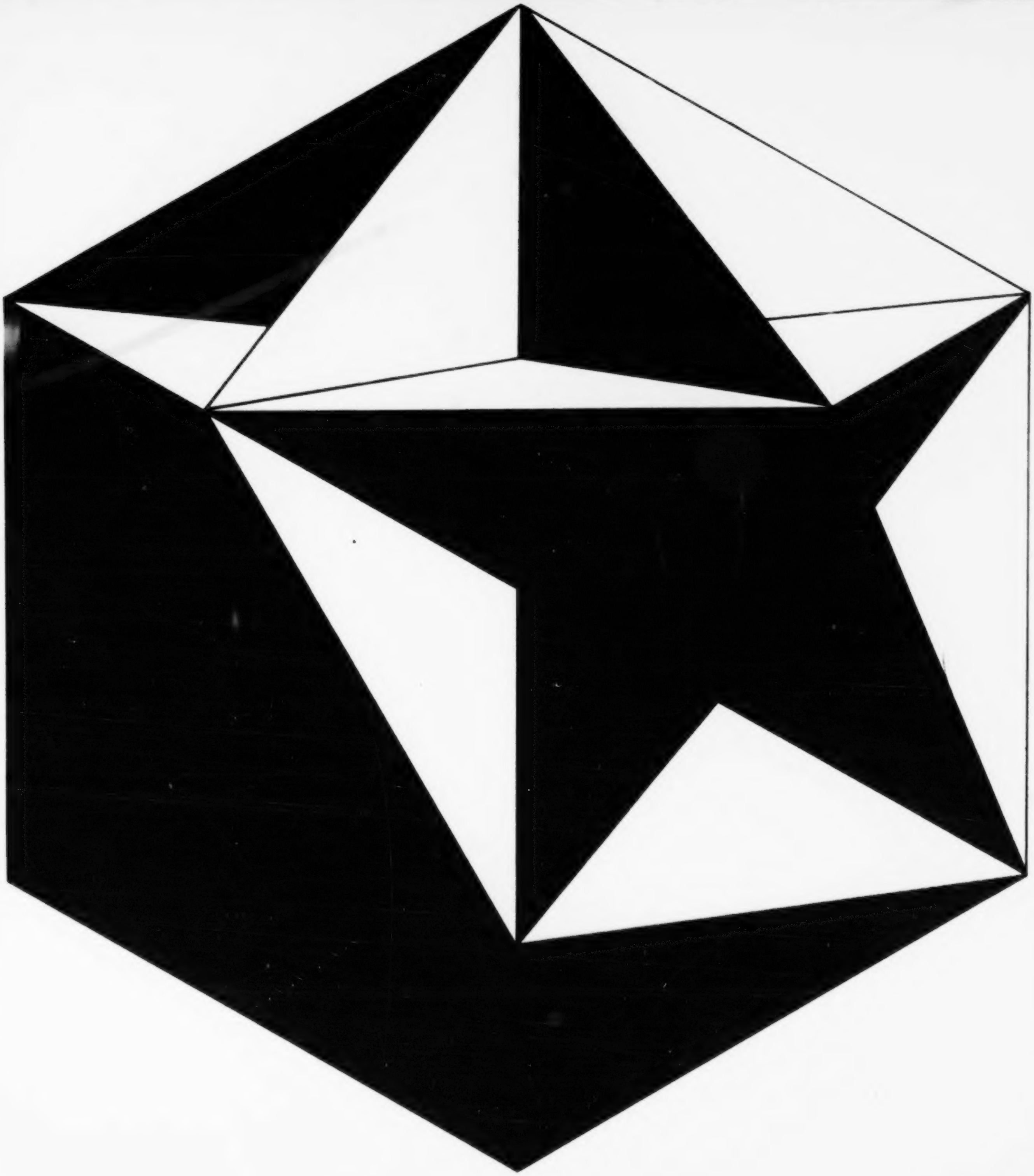

SEEDBED

SEEDBED

Number 10
November, 1981

Teachers' Center Project

SIUE

Southern Illinois University
at Edwardsville

INTRODUCTION TO SEEDBED

The week of August 17-21, 1981 was the time for the Teachers' Center Project's tenth annual summer course.

Dick Tahta (University of Exeter), one of the spiritual fathers of the Association of Teachers of Mathematics (UK) and also of Leapfrogs (an informal group of math educators who collaborate in developing thoughtful, innovative math materials and films) joined Tom O'Brien to comprise the staff for the course.

Much of the work was on visual thinking—an area that was already of interest to some but for all practical purposes new to almost all of the 25 participants.

SEEDBED 10 is the result of that week. Some of the articles were written during the course and others result from teachers' tryouts after they got back to their classrooms and had had the chance to try out some of their new-found ideas with kids.

Try these ideas yourself—don't just read about them—and then give your kids a go at them. The thinking involved is rich and exciting and very open to extension.

We urge you to write about your observations as your students work on these issues and send the articles to us for possible inclusion in future issues of SEEDBED. Childwatching is such a worthwhile undertaking and sharing your observations has a ripple effect—the ideas don't die—they just keep going and growing and kids are the beneficiaries.

We are grateful to Linda McDonnell, one of the course participants, for making available her newly started classroom journal. The work, done by second graders at Parkview Elementary School, Granite City, is a) lovely in itself and b) suggestive of something teachers might commence in their own classrooms.

We are grateful to course participants for sharing their ideas and we are grateful to Dick Tahta for the richness and care he brought to the summer course.

Shirley A. Casey

Shirley A. Casey

Thomas C. O'Brien

Edwardsville, Illinois
November 16, 1981

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About the Cover

The design on the cover of SEEDBED 10 is a copy of the Leapfrogs' poster that Dick Tahta used so effectively during the summer course. Several of the articles refer to the poster.

The original poster is available from the publishers, Tarquin Publications. The catalog description is as follows:

P6 3-WAY DODECAHEDRON

> *Multi-colored screenprint. A particular colouring of the faces of a great dodecahedron provides a picture that can be construed as a three-dimensional object in at least three ways. Approximately 90 cm X 63 cm. Delivered in stout cardboard tube. Cost is £ 1.50 + £ 1 packing and postage.*

Tarquin Publications will include a catalog of other Leapfrogs' materials with your order. Mail orders to:

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England

THE SEEDS

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Fishing

Dick Tahta

A Chinese sage once compared talking to fishing. Words are used to convey ideas as a fishing net is used to catch fish. When ideas are apprehended we can forget the words just as we can take the fish and forget the net.

"How delightful," said Chuang Tzu, "to be able to talk with such a man who had forgotten the words."

Here is an exercise in fishing for the reader. The following transcription presents a brief snatch of classroom dialogue. Read it through carefully.

Teacher: Take 87 from 835.

Michael: Take 35 from 87, leaves 32.
Take 35 from 835, that leaves 768
.... I think.

Teacher: Not quite.

Claire: 728.

Teacher: Guessing, Claire?

What do you think is happening here? Read the transcript through again and formulate your reaction before reading on.

Why does the teacher think Michael has 'not quite' got somewhere?

Why does the teacher think Claire is guessing?

Throw away the nets -- what fish are the children catching?

The trouble with this sort of exercise is that nobody knows the answers. Michael and Claire aren't here to tell us. But it is always useful to fish for possible interpretations by assuming that they know what they are doing and that our task might be to make plausible reconstructions of this.

Can you make plausible reconstructions of Michael's thoughts? (See note 1 for a possible version -- there could be many more.)

I can never know what goes on in Michael's head -- I have only got his words. Rather than assume that he is trying to do what I do I can try to reconstruct what he does and discuss this with him. The "answer" to the proposed problem is the least of our joint concerns and will look after itself in due course.

Here is another exercise.

Teacher: 431 subtract 135.

John: First of all I took 135 and doubled it making 270.
Then I took, mmm ...., 405 away from 431.
No, that's not right (giggles).
I took 405 away so that left me with 27,
eh, ... two hundred and .....

Can you make a plausible reconstruction of John's thoughts? (See note 2.)

I wanted to work on these transcripts with people during the recent Teachers' Center course but there was no suitable opportunity. However, the exercises do seem relevant to the fishing we did do. Fish also appear in a comment by an English poet, Ted Hughes, with which I would like to end this contribution.

> "There is the inner life, which is the world of final reality, the world of memory, emotion, imagination, intelligence, and natural common-sense, and which goes on all the time, consciously or unconsciously, like the heart beat. There is also the thinking process by which we break into that inner life and capture answers and evidence to support the answers out of it. That process of

raid, or persuasion, or ambush, or dogged hunting, or surrender, is the kind of thinking we have to learn and if we do not somehow learn it, then our minds lie in us like fish in the pond of a man who cannot fish."

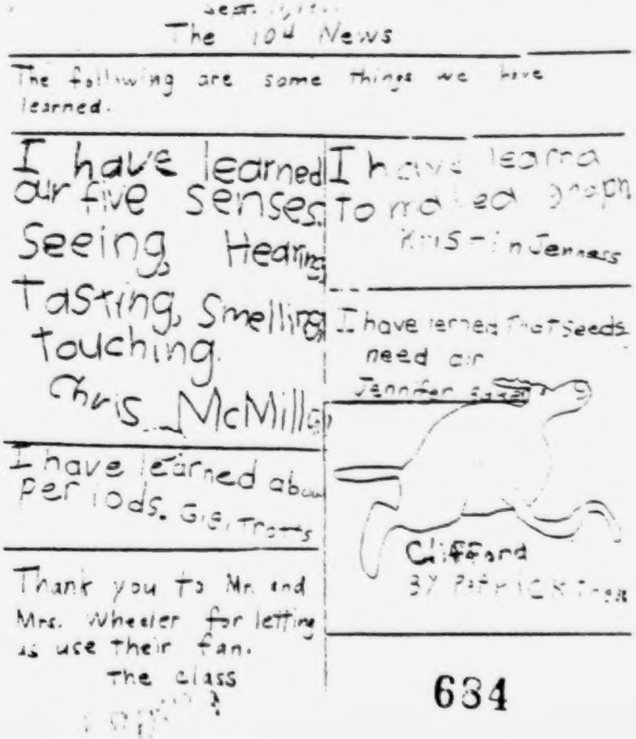
Note 1.

Michael could be performing 835 - 87 as 800 - (87 - 35) and so 800 - 32 (a mistake for 52?) giving 768 (which is mistakenly verbalized as 835 - 35?). His "I think" suggests possible self doubt. Claire might be correcting his - 32 to - 40 (still mistakenly but hardly guessing?).

Note 2.

John doubles 135 giving 270 then adds another 135 to give 405, which is then taken from 431 leaving 27 (mistake for 26?). Is he "seeing" 431 as made up of three 135's and a 27? Subtracting one of these 135's would leave him two and the 27. Is he about to perform 270 and 27 (which would give him 297 - mistake for 296)?

* * * * * * *



Sept. [illegible]

The 104 News

The following are some things we have learned.

I have learned our five senses. Seeing, Hearing Tasting, Smelling touching.
Chris McMill

I have learna To ma[illegible] a graph
Kristin Jenness

I have lerned that seeds need air
Jennifer [illegible]

I have learned abou periods. Gigi Trotts

Clifford
BY Patrick [illegible]

Thank you to Mr. and Mrs. Wheeler for letting us use their fan.
The class

At the Blackboard

One of the most provocative moments of the summer course was Dick Tahta's reading of a selection from Jules Henry's Culture Against Man. The selection follows.

> "Boris had trouble reducing '12/16' to the lowest terms and could only get as far as '6/8'. The teacher asked him quietly if that was as far as he could reduce it. She suggested he 'think'. Much heaving up and down and waving of hands by the other children, all frantic to correct him. Boris pretty unhappy, probably mentally paralyzed. The teacher, quiet, patient, ignores the others and concentrates with look and voice on Boris. She says, 'Is there a bigger number than two you can divide into the parts of the fraction?' After a minute or two, she becomes more urgent, but there is no response from Boris. She then turns to the class and says, 'Well, who can tell Boris what the number is?' A forest of hands appears, and the teacher calls Peggy. Peggy says that four may be divided into the numerator and the denominator."

Thus Boris' failure has made it possible for Peggy to succeed; his depression is the price of her exhilaration; his misery the occasion for her rejoicing. This is the standard condition of the American elementary school, and is why so many of us feel a contraction of the heart even if someone we never knew succeeds merely at garnering plankton in the Thames: because so often somebody's success has been bought at the cost of our failure. To a Zuni, Hopi, or Dakota Indian, Peggy's performance would seem cruel beyond belief, for competition, the wringing of success from somebody's failure, is a form of torture foreign to those noncompetitive redskins. Yet Peggy's action seems natural to us; and so it is. How else would you run our world? And since all but the brightest children have the constant experience that others succeed at their expense, they cannot but develop an inherent tendency to hate--to hate the success of others, to hate others who are successful, and to be determined to prevent it.

Along with this, naturally, goes the hope that others will fail. This hatred masquerades under the euphemistic name of 'envy'."

*This excerpt is taken from Jules Henry's book Culture Against Man, pp. 295-296, published by Random House, 1963.

* * * * * * * *

Concentration

Marie Reeves

In our math class with Tom O'Brien and Dick Tahta, we did an experiment on concentration and counting while listening to a tape with the sound of a note being made over and over at different intervals. We were to count the number of times we heard the note. Then we attempted to keep track of two sounds at once, a high tone and a low tone.

I did this experiment with 28 fifth and sixth graders. They had little trouble keeping track of one tone until about thirty. About one-third of the class became confused beyond that.

Most of them could keep track of the two separate tones to about five (example: six high tones, four low tones). Many were using their fingers and ran out of fingers. Only four were able to keep separate count of the sounds much higher. One of those four said he kept the low sound on one side and the high sound on the other side. Another said he kept the high tones in the ten's column and the low tones in the one's column. One girl drew a table in her mind (high/low). The other student, a boy, pictured a cash register, low tones were dollars and high tones were cents.

Slide and Jump

T. C. O'Brien

One of the activities of the summer course was Slide and Jump. One starts with two colors of chips in a layout such as (A) and tries, using only slides and jumps to get to situation (B). In any move, only one piece can be moved and at most one piece can be jumped in a single move.

(A) ● ● O 0 0

(B) 0 0 O ● ●

Here is a series of moves which might be used:

(A) ● ● O 0 0
● O ● 0 0
● 0 ● O 0
● 0 ● 0 O
● 0 O 0 ●
O 0 ● 0 ●
0 O ● 0 ●
0 0 ● O ●
(B) 0 0 O ● ●

One can, of course, play with three, four or even one hundred pieces on a side. (How many moves would that take?)

When we played the game, however, we used people. Men and women were the pieces; half the group played and half watched and kibitzed.

PLAYERS 0 0 0 0 0 O ● ● ● ● ●

OBSERVERS O O ● O O O ● O
● ●
●

I had played the game with coins and checkers but I had never been a piece before. To do so was illuminating not so much with respect to the game but with respect to learning and educational situations in general. My observations now seem all the more important since it evolved that three main aspects of the week were that 1) knowledge is a construction, 2) knowledge is a very personal thing, and 3) one can learn a great deal about knowledge by looking at one's own constructions.

Observation 1

I learned very quickly to pick up clues and hints from the chatter of observers and my fellow players. From them I learned to sense when it was my turn to move to the next space and, since there were only two things to do on one's turn -- slide or jump -- I was able to perform quite decently.

Observation 2

I learned to sense a rhythm to the play. I can't reconstruct it now, but it was something like 1) listen for another player to move, 2) pause, 3) listen for another move, 4) pause, 5) look to see whether a space at my right was empty (I was rightward moving), 6) if empty, do something.

Observation 3

I felt clear throughout the game that I hadn't the foggiest idea about how the game was played, yet I felt increasingly confident that I would be able to carry out my "play" when my turn came. (Essentially, my focus grew limited to one question, "Is it my turn?" Knowing that, I could proceed.)

Observation on Observation 1

My strong bet is that much of what children learn they learn from one another.

Observation on Observation 2

Do we, as teachers, know what has been learned by children? We are concerned about Issue X. We spend our time and children's time on Issue X. As Piaget in Science of Education points out, we usually have no notion whatsoever of what children have made of Issue X both in the short term and in the long term.

Observation on Observation 3

I felt strongly when the game was finished that there is a big difference between local knowledge and -- what shall we call it? -- global knowledge. Or, better, between bits and tricks on the one hand and an overall understanding (and with it generalizability, predictability, a sense of control) on the other. I had clearly learned bits and tricks and had mastered my own local play as end man on the "team," but I had no notion whatsoever of anything beyond local tactics. On the other hand, when we played the game collaboratively with pennies (heads vs tails) later, a general strategy (with generalizability, predictability, control) evolved very quickly.

There are several questions then. What questions can you see? The biggest one for me is the issue of local vs. global knowledge. Is this a sensible distinction? A second question is this: "Do we as teachers often interpret smooth functioning as intelligent functioning?" I am clear that I was able to play the game smoothly and I am also sure that I played the game unintelligently in all but the most narrow local sense.

Is this local vs global distinction applicable only to "Slide and Jump"?

Number Patterns Using the Multiplication Tables

Anne Betscher, Annemarie Garcia, Marjorie McEnany,
Arlene Plog and Louise Rider

Given this multiplication chart, the class was asked to look for number patterns. Our group made the following observations:

I. Patterns

A. Obvious patterns in horizontal and vertical rows and columns.

B. The nines column is unusual because the sum of the digits is nine.

MULTIPLICATION TABLE

X	0	1	2	3	4	5	6	7	8	9
0	0	0	0	0	0	0	0	0	0	0
1	0	1	2	3	4	5	6	7	8	9
2	0	2	4	6	8	10	12	14	16	18
3	0	3	6	9	12	15	18	21	24	27
4	0	4	8	12	16	20	24	28	32	36
5	0	5	10	15	20	25	30	35	40	45
6	0	6	12	18	24	30	36	42	48	54
7	0	7	14	21	28	35	42	49	56	63
8	0	8	16	24	32	40	48	56	64	72
9	0	9	18	27	36	45	54	63	72	81

II. Use of the table

A. Obvious use of finding the products of single-digit numbers:

Example: 5 X 5 = 25

MULTIPLICATION TABLE

X	0	1	2	3	4	5	6	7	8	9
0	0	0	0	0	0	0	0	0	0	0
1	0	1	2	3	4	5	6	7	8	9
2	0	2	4	6	8	10	12	14	16	18
3	0	3	6	9	12	15	18	21	24	27
4	0	4	8	12	16	20	24	28	32	36
5	0	5	10	15	20	25	30	35	40	45
6	0	6	12	18	24	30	36	42	48	54
7	0	7	14	21	28	35	42	49	56	63
8	0	8	16	24	32	40	48	56	64	72
9	0	9	18	27	36	45	54	63	72	81

B. Progression to multiplying larger numbers.

1. Example: 2 X 12 = 24

MULTIPLICATION TABLE

X	0	1	2	3	4	5	6	7	8	9
0	0	0	0	0	0	0	0	0	0	0
1	0	1	2	3	4	5	6	7	8	9
2	0	TENS ②	ONES ④	6	8	10	12	14	16	18
3	0	3	6	9	12	15	18	21	24	27
4	0	4	8	12	16	20	24	28	32	36
5	0	5	10	15	20	25	30	35	40	45
6	0	6	12	18	24	30	36	42	48	54
7	0	7	14	21	28	35	42	49	56	63
8	0	8	16	24	32	40	48	56	64	72
9	0	9	18	27	36	45	54	63	72	81

2. Example: 5 X 12 = 60

(ten ones and five tens)

MULTIPLICATION TABLE

X	0	1	2	3	4	5	6	7	8	9
0	0	0	0	0	0	0	0	0	0	0
1	0	1	2	3	4	5	6	7	8	9
2	0	2	4	6	8	10	12	14	16	18
3	0	3	6	9	12	15	18	21	24	27
4	0	4	8	12	16	20	24	28	32	36
5	0	⑤ tens	⑩ ones	15	20	25	30	35	40	45
6	0	6	12	18	24	30	36	42	48	54
7	0	7	14	21	28	35	42	49	56	63
8	0	8	16	24	32	40	48	56	64	72
9	0	9	18	27	36	45	54	63	72	81

3. Example: 12 X 34 = 408

(8 ones, 10 tens and

3 hundreds)

MULTIPLICATION TABLE

X	0	1	2	3	4	5	6	7	8	9
0	0	0	0	0	0	0	0	0	0	0
1	0	1	2	③	④	5	6	7	8	9
2	0	2	4	⑥	⑧	10	12	14	16	18
3	0	3	6	9	12	15	18	21	24	27
4	0	4	8	12	16	20	24	28	32	36
5	0	5	10	15	20	25	30	35	40	45
6	0	6	12	18	24	30	36	42	48	54
7	0	7	14	21	28	35	42	49	56	63
8	0	8	16	24	32	40	48	56	64	72
9	0	9	18	27	36	45	54	63	72	81

Note: To multiply two 2-digit numbers, locate the digits of one number on one axis and the digits of the other number along the other axis. Then locate the products. There will be four products. The lower right hand number will be the ones, the sum of the lower left and upper right numbers will be the tens and the upper left number will be the hundreds. Often you will need to rename or carry to the next place value.

4. Example: 46 X 67 = 3082

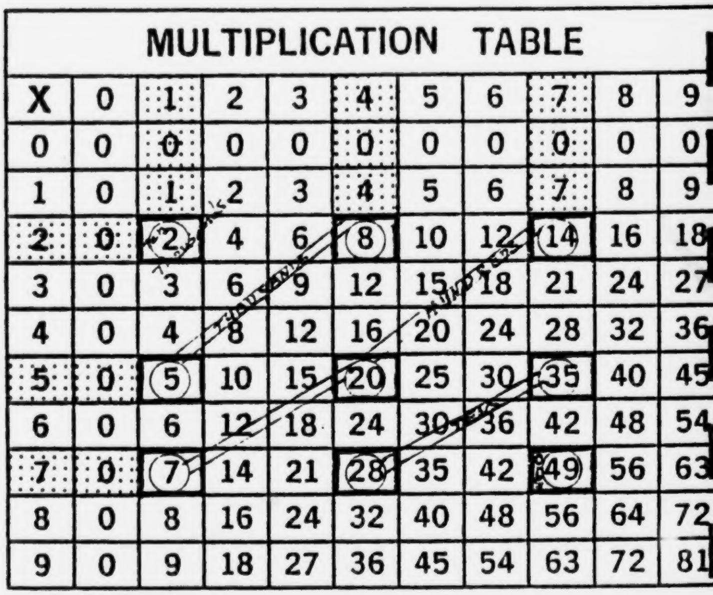
(42 ones, 64 tens and 24

hundreds)

MULTIPLICATION TABLE

X	0	1	2	3	4	5	6	7	8	9
0	0	0	0	0	0	0	0	0	0	0
1	0	1	2	3	4	5	6	7	8	9
2	0	2	4	6	8	10	12	14	16	18
3	0	3	6	9	12	15	18	21	24	27
4	0	4	8	12	16	20	24	28	32	36
5	0	5	10	15	20	25	30	35	40	45
6	0	6	12	18	24	30	36	42	48	54
7	0	7	14	21	28	35	42	49	56	63
8	0	8	16	24	32	40	48	56	64	72
9	0	9	18	27	36	45	54	63	72	81

5. Example: 147 X 257 = 37779 (49 ones, 63 tens, 41 hundreds, 13 thousands and 2 ten-thousands)



MULTIPLICATION TABLE

X	0	1	2	3	4	5	6	7	8	9
0	0	0	0	0	0	0	0	0	0	0
1	0	1	2	3	4	5	6	7	8	9
2	0	2	4	6	8	10	12	14	16	18
3	0	3	6	9	12	15	18	21	24	27
4	0	4	8	12	16	20	24	28	32	36
5	0	5	10	15	20	25	30	35	40	45
6	0	6	12	18	24	30	36	42	48	54
7	0	7	14	21	28	35	42	49	56	63
8	0	8	16	24	32	40	48	56	64	72
9	0	9	18	27	36	45	54	63	72	81

THOUSANDS
HUNDREDS
TENS

We think this chart is a handy calculator. We can get the answer from this chart with a minimal amount of work. Can you multiply 532 X 54? Try it! (Using the chart, of course!)

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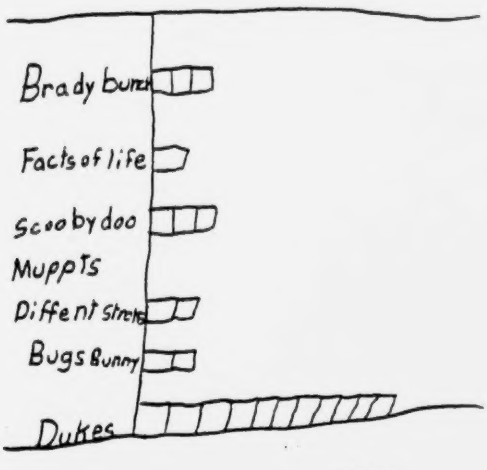
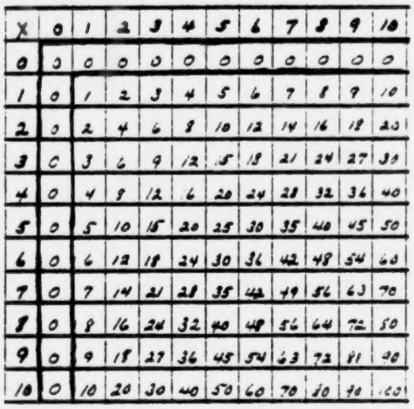
Our favorite T.V. Shows.
by Stacy Sturdivant Jennifer Bake.



Patterns

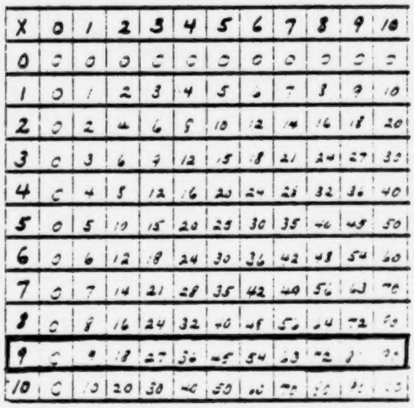
Anne Betscher

We talked about patterns in the floor, of the concrete blocks in the wall, and of the holes in the ceiling tiles. We had discussed multiplication, its meaning, and how to find unknown products in several ways on the previous day. At the beginning of math I gave my students the multiplication table grid and asked them to fill it in. The purpose was to use the "answer-finding" methods we had discussed the previous day. After the students had worked on the table for some time, I asked them to find and color one pattern. Here are some of the results.



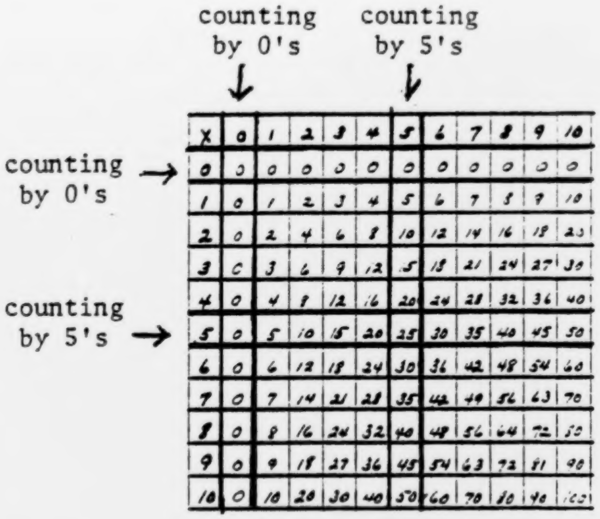
X	0	1	2	3	4	5	6	7	8	9	10
0	0	0	0	0	0	0	0	0	0	0	0
1	0	1	2	3	4	5	6	7	8	9	10
2	0	2	4	6	8	10	12	14	16	18	20
3	0	3	6	9	12	15	18	21	24	27	30
4	0	4	8	12	16	20	24	28	32	36	40
5	0	5	10	15	20	25	30	35	40	45	50
6	0	6	12	18	24	30	36	42	48	54	60
7	0	7	14	21	28	35	42	49	56	63	70
8	0	8	16	24	32	40	48	56	64	72	80
9	0	9	18	27	36	45	54	63	72	81	90
10	0	10	20	30	40	50	60	70	80	90	100

Zero times
anything is
always zero.



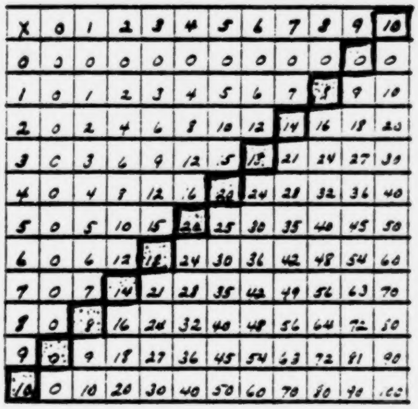
X	0	1	2	3	4	5	6	7	8	9	10
0	0	0	0	0	0	0	0	0	0	0	0
1	0	1	2	3	4	5	6	7	8	9	10
2	0	2	4	6	8	10	12	14	16	18	20
3	0	3	6	9	12	15	18	21	24	27	30
4	0	4	8	12	16	20	24	28	32	36	40
5	0	5	10	15	20	25	30	35	40	45	50
6	0	6	12	18	24	30	36	42	48	54	60
7	0	7	14	21	28	35	42	49	56	63	70
8	0	8	16	24	32	40	48	56	64	72	80
9	0	9	18	27	36	45	54	63	72	81	90
10	0	10	20	30	40	50	60	70	80	90	100

In the 9's, the first
number (tens) goes up
and the second number
(ones) goes down.


counting by 0's
counting by 5's
counting by 0's
counting by 5's

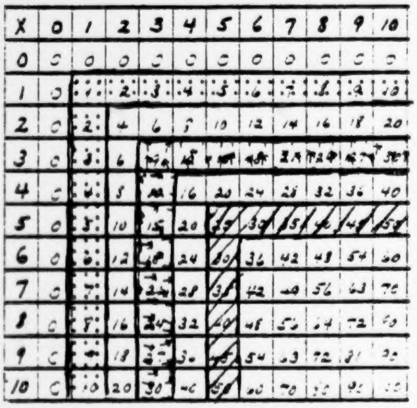
X	0	1	2	3	4	5	6	7	8	9	10
0	0	0	0	0	0	0	0	0	0	0	0
1	0	1	2	3	4	5	6	7	8	9	10
2	0	2	4	6	8	10	12	14	16	18	20
3	0	3	6	9	12	15	18	21	24	27	30
4	0	4	8	12	16	20	24	28	32	36	40
5	0	5	10	15	20	25	30	35	40	45	50
6	0	6	12	18	24	30	36	42	48	54	60
7	0	7	14	21	28	35	42	49	56	63	70
8	0	8	16	24	32	40	48	56	64	72	80
9	0	9	18	27	36	45	54	63	72	81	90
10	0	10	20	30	40	50	60	70	80	90	100

It shows you how to count by 0's, 1's, 2's, 3's, 4's, 5's, 6's, 7's, 8's, 9's and 10's. It shows each one twice--across and down.



X	0	1	2	3	4	5	6	7	8	9	10
0	0	0	0	0	0	0	0	0	0	0	0
1	0	1	2	3	4	5	6	7	8	9	10
2	0	2	4	6	8	10	12	14	16	18	20
3	0	3	6	9	12	15	18	21	24	27	30
4	0	4	8	12	16	20	24	28	32	36	40
5	0	5	10	15	20	25	30	35	40	45	50
6	0	6	12	18	24	30	36	42	48	54	60
7	0	7	14	21	28	35	42	49	56	63	70
8	0	8	16	24	32	40	48	56	64	72	80
9	0	9	18	27	36	45	54	63	72	81	90
10	0	10	20	30	40	50	60	70	80	90	100

It starts the same and ends the same. It's tricky! It goes up and comes back down.



X	0	1	2	3	4	5	6	7	8	9	10
0	0	0	0	0	0	0	0	0	0	0	0
1	0	1	2	3	4	5	6	7	8	9	10
2	0	2	4	6	8	10	12	14	16	18	20
3	0	3	6	9	12	15	18	21	24	27	30
4	0	4	8	12	16	20	24	28	32	36	40
5	0	5	10	15	20	25	30	35	40	45	50
6	0	6	12	18	24	30	36	42	48	54	60
7	0	7	14	21	28	35	42	49	56	63	70
8	0	8	16	24	32	40	48	56	64	72	80
9	0	9	18	27	36	45	54	63	72	81	90
10	0	10	20	30	40	50	60	70	80	90	100

The numbers go the same way. There are patterns all over the page.

Stars

Thomas C. O'Brien

1. These people see three stars and I can only see two.

2. Wow!

3. I have always been sure that thoughts can/do differ from one person to another.

    3.1 Certainly beliefs differ -- you are a Methodist, I a Baptist, etc.

    3.2 And interpretations of even the very same facts can differ from one person to another. (Shall you and I discuss Richard Milhouse Nixon?)

4. One of the major findings of Piagetian research is that we interpret reality, we screen it, we re-form it in terms of our existing networks of ideas. No problem there.

5. But for perception to differ so widely from person to person!! These people SEE things that I don't see and it's not a matter of eyesight, color blindness, physical deficiency. They SEE something and that something is very different from Joe to Sally to Joan to me.

6. This must mean that perception is not the mechanical (camera-like) thing one supposes. Perception -- the very act of seeing, in this case -- involves cognition. Wow.

7. Now they are saying that there are 12, 16, 18 stars. I have by now found that #$%¢&*#X third one and can make a start (but only a start) at seeing what they call the partially hidden stars.

Imagery

Annemarie Garcia

During the week Dr. Dick Tahta lead us to experience several types of mental imagery. We had to think about thinking. With eyes closed we counted sounds of many types, drew triangles, lines, circles and squares in our minds and imagined creatures while being read a descriptive paragraph.

These activities were at first very difficult and tiring but yet very exciting. To be able to think about thinking takes practice and good concentration and can be an extremely useful tool for learning mathematics. Students have an alternate way of doing a problem without pencil or paper.

My classes call it "mental computation." This year instead of having the students do several review worksheets on the basic operations of whole numbers, I asked them to do many review problems without a pencil or paper. Instead they used the pencil and paper of mental imagery. At first the majority of students could not do the problems in their heads and picked up the pencil, even though some of the problems were extremely simple. Several students became frustrated. They said that they could not do the problems using mental imagery but they felt they needed pencil and paper. We worked at least 5-10 minutes per day on mental computation for about two weeks. Each day, I could see the students feeling more comfortable with the activity. Several students took turns making and reading the problems (ex: $16 + 5 - 1 \div 5 = ?$). Many times they would remind me it was time for "mental computation." They love it!

But most of all my students learned another way to do a problem without using pencil and paper. They learned to think about thinking.

* * * * * * * *

Making A Mental Construction

Bill Brainerd

My immediate first impression of the geometrical figure (on the cover) was that of a 5 pointed star on a red background such as a brigadier general might wear. This percept dominated me for a time. I had had enough experience with such geometrical figures to know there had to be something else. I muddled around mentally and shifted perceptual gears and identified the star on the left on the yellow background. My perception had expanded some and probably would have stagnated at that point without the probing and interaction of our table group and later the class as a whole. Thus my original perception eventually began to approach in some degree that of the artist's generative conception.

We counted the 3 stars and the 3 partial stars, noted the hexagon outline of the figure, the 3 different colored pentagons, and the indented pyramid. We visualized the cube shape of the figure, and the 4 sided rectangular figure that made up the cube.

I began something like the naive geographer who perceives the world as flat - i.e., I began with a one dimensional impression of the figure. But interacting with others I eventually mentally constructed something of the complexity of the figure.

The Trap

Linda McDonnell

After two days of shut-eye work in math, I decided to pretest my class. I found that there was a group that knew the material in the first chapter and a group that didn't. I decided that the former group did not need page by page instruction and practice. So I thought, "Let that group do the thirty pages independently and check themselves. Then I'll record their grades." . . .Oh, no! The Trap! I fell into the trap--the trap that makes math boring for kids and turns them off thinking. This trap can also make teachers think that all the pages of a textbook must be completed. Stop. Backtrack. What to do?

The next day I had two groups in math. One group worked with Cuisenaire Rods while the other group and I tore out pages from the math workbooks. Now the children had a problem. They didn't want to skip the pages. So we talked and we tried some of the problems from those pages orally. We all decided that we knew the answers and that we didn't need practice. Later we did a graph together. The children rolled one die and recorded the numbers as they came up on a graph. They found their "Lucky Number". It was interesting and fun.

The other group and I had been working on imagery. I found that I could better help the children to construct the problem mentally if we worked one to one, as a problem arose. Nicole was "stuck" on 4 + 2. So I asked her to close her eyes and think of 4. Then I asked her to think of 2 more. . .6! She did it! It worked! It was so fulfilling to see her expression, her smile, and her pride as she "saw" the answer.

Well, I know that I'll find more traps ahead, but I didn't fall into this one!

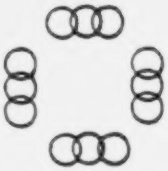
* * * * * *

Brain Teasers

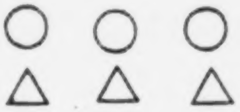
Chuck Shelhamer

Begin each week with a good brain teaser. How many students can solve the problem by week's end? Two good ones to start with are:

1) A jeweler has four pieces of chain of three links each. He wants to join them into one continuous chain of twelve links. He wants to join them by breaking and joining as few links as possible. Anyone can do it by breaking four links, but can you help him do it by breaking only three?



2)



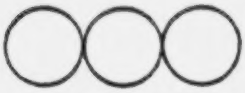
Connect each circle to each triangle with no intersecting lines.

Answers: 1) Break each link in one of the sets of three. Use each broken link to join two ends of the other three sets.
2) This problem is impossible to solve, but the students won't believe it even if you tell them. They will do a lot of thinking to prove you wrong.

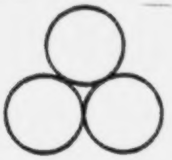
Animals

Annemarie Garcia

Dick Tahta showed us a movie made by a group of six-year-olds. The movie was about "animals". These "animals" were made by using bingo chips. An animal is an animal if by moving only one chip at a time, the animal can move all across your paper. However, the shape of the animal must be restored with each move. Examples of animals:



This animal can only move horizontally in this position.



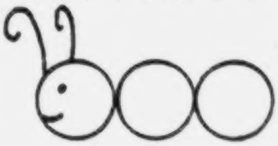
This animal moves diagonally.

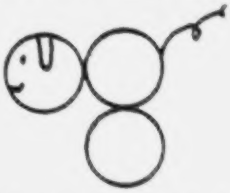
After studying the moves and shapes of many 3 and 4 chip animals, I created this game. Try it!

Desert Crossing

Directions:

Use one of the following "animals" and see if you can cross the desert without landing directly in the water (the darker shaded squares). Remember, an "animal" moves by moving one chip at a time and each move must create a similar animal.

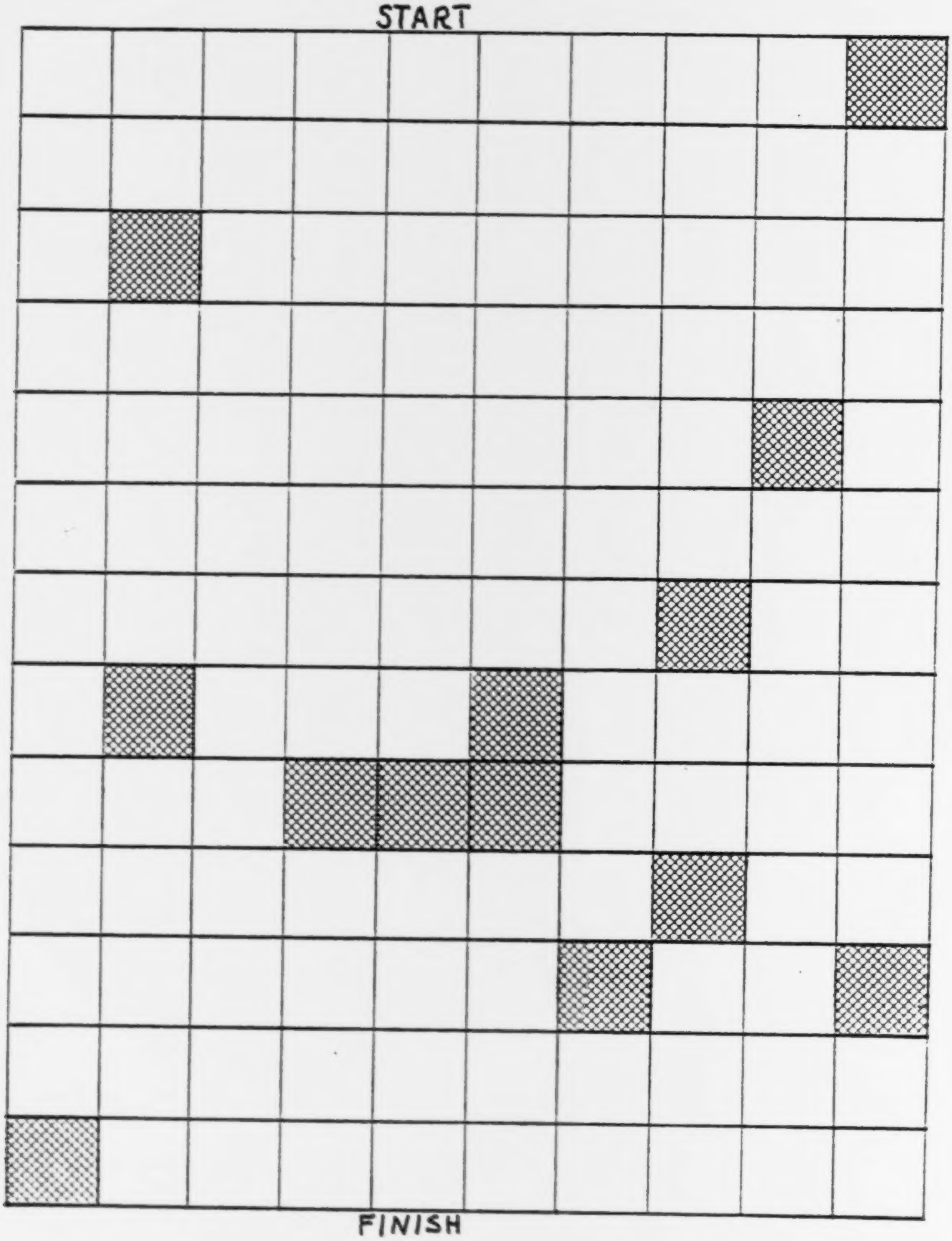




Note: When starting on the game board only one chip can be in the first column next to Start.

A. Record the number of moves.

B. Is there a position on the game board for each animal which would result in the least number of moves to get to Finish (off the board)?

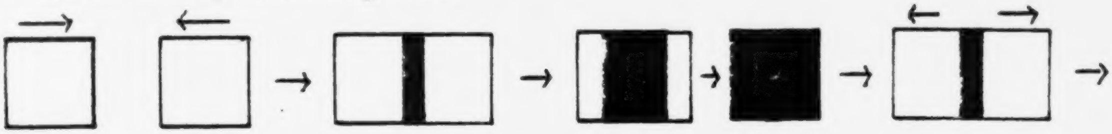

START
FINISH

Leapfrogs' Intersections

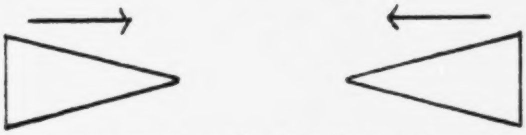
Shirley Casey

One of the interesting things that a small group of us worked on during the summer course grew from one of the Leapfrogs TV programs (ATV).

In the program, two identical geometric shapes approached each other, crossed and continued on. As they crossed, their intersections were shown in a second color, something like:



Dick asked some of us who were interested to mentally envision what would happen if two isosceles triangles approached one another point on.



What would the first intersection look like? How about when approximately one-fourth of each figure overlapped the other? Half? Three-fourths? Seven-eighths? Can you make a series of drawings of just the intersections?

Does changing the angle of orientation (attitude) of the triangles make a difference? If you were given just the series of intersections, could you reconstruct the original figures?

Try it yourself and give kids a go at it!

A Dodecahedron

Syvella Gregory

A what??? This was an exercise in problem solving. On a poster was a geometric figure in radiant colors of yellows, reds, and oranges. What the participants were to do was to share what they saw in the figure.

Each participant saw something different. Each of us described aloud what we saw and tried to help others see the same thing. "Now come on, don't you see the star?" "Here's one, there's one." "Oh, yes, now I see the stars." If you didn't see the stars, you must have seen the triangles. If you didn't see the triangles, you definitely saw the pyramids. The stars, triangles and pyramids' locations were described by colors.

The colors were vivid. Yellow was described as mustard, sun-yellow and chartreuse. Red was described as a wine color. Orange was described as a sand color. All participants saw a rainbow of colors. This presented some difficulty in the explanation of exactly where the stars, triangles and pyramids were. No one admitted to being colorblind. There was an occasional chorus of, "Now I see!"

Moving from the concrete stars, triangles and pyramids to the abstract or the back of the figure was difficult. The back of the figure was not pictured. Oh, there were some jokes like, "You have to go into the next room to see the back of the figure". We surmised that there were five or six stars back there. Some of us said, "Fine, there are twelve stars on that figure! The end."

Other participants went home that night and pondered. They made three-dimensional models of the figure from paper or from cardboard pentagons and triangles. Their wheels continued to turn.

It is beyond this participant's knowledge whether or not they ever did reach closure on this issue. One thing is for sure. I plan to purchase that poster so that I can take a long look and find all those pyramids. Then I think I'll see what my students can see.

* * * * * * * * *

Seven, Eleven and Lucky Thirteen

Dennis Craft

Here is a "trick" which never fails, and the victim of our trick must do all the computations. Have the student pick any 3 digit number, for an example:

1.	Pick any number.	647
2.	Repeat the same three digits to form a six-digit number.	647,647
3.	Divide the number by 7.	647,647 ÷ 7 = 92,521
4.	Divide that number by 11.	92,521 ÷ 11 = 8,411
5.	Divide that number by 13.	8,411 ÷ 13 = 647

The answer is the number you began with! You will never have a remainder.

Note - This is a variation of Peter Wason's problem from Thinking and Reasoning.

Behind Closed Eyes

Marie Reeves

One of the things we did in our class with Dick Tahta was to close our eyes and imagine a ball rolling along a horizontal line. I tried it with a class of 30 fifth and sixth graders. I asked them to tell me whether they could picture it or not. All said that they could. Then I asked them to write down the color of the line, the color of the ball, what direction the ball went, and what happened when the ball got to the end of the line. I also asked them to include anything else they had seen.

All the children said they saw the images in colors. Although more saw the ball roll from left to right, many saw it rolling from right to left. Most saw the ball fall off at the end of the line, but one boy said it "fell upward".

Some interesting results were:

Susan - I saw it.
The color of the line was yellow.
The color of the ball was red.
It rolled from right to left.
At the end was a lion's mouth and the ball bounced into it.
It was rolling very fast.

Stephanie - Yes, I saw it.
The line was black.
The ball was red.
Right and left--back and forth.
It wouldn't stop until I opened my eyes.
Two people were playing ball rolling it back and forth,

but I couldn't see the people.
It was weird.

Monica - I saw a ball rolling on a line.
The line was red, green and yellow.
The ball was rainbow colored.
It was rolling in many circles like it was dizzy.
At the end, music from Beethoven's 7th Symphony started to play and it disappeared.

Karen - Yes, I saw it.
The line was yellow.
The ball was red the first time and blue the second.
It rolled toward the left.
The line went on forever.
The ball just got smaller as it went on and on and on.
The line was very bright and the ball was just a shadow.
I saw it roll by twice.

* * * * * * * *

Helen Keller

by Melissa Schoeber

I am writing on Helen Keller because She was my great grand mothers fourth Cousin. She was deaf and blind. She learned to talk and to read brail. She went to many Places and talked to People. She also wrote many books.

Brain Storm!!

Linda McDonnell

There's a storm in my brain --
The ideas fly so,
It's a hurricane!

One night I was thinking of things to do in math. I began writing them down. Soon my list departed from some of the ideas that I learned from the Teachers' Center Project. I began thinking of some old ideas, but in a new way. We were learning about seeds in science. How could I help the children to "construct" their own knowledge about seeds? I began writing down ideas and this is what happened.

First, we closed our eyes and imagined an apple. Then we imagined it cut in half. What do you see? What color are the seeds? It was amazing--the accuracy of their images was amazing! We continued with other fruit successfully, until I asked them to imagine an orange and cut it into halves. Most could not tell me the color of the seeds. At first, I thought that some were not trying, or, that they were not getting a mental picture. But then, it occurred to me--they were seeing navel oranges! No seeds!

The next day, the children brought fruit and I brought my cutting board, a sharp knife, and a silver tray. I cut the fruit into halves (most of the ones from the shut-eye work the day before). We saw the insides of the fruit and the seeds. We smelled the fruit. And then, best of all, we got to taste the fruit. Yum!

The next day, I placed the seeds from the cut fruit on numbered cards. The children identified the name of the fruit from its seed(s) and then they described them, big or small. After they've dried, we can plant them.

Planned for next week is a walk to my house to collect seeds. We will plant some of them as well as some of the seeds from the fruits we enjoyed.

Egad! Is this me? Now I know I can do it . . . I can really do it! The possibilities are limitless.

* * * * * * * *

Making Bats
by Chris Mcuillan
We are making bats
for halloween. This
is how to do it.
1. You take a long
black piece of paper
then take a Shorr
piece of black paper.
2. You take the long
piece of paper and
fold it back and forth.

3. You take the Short
piece of paper and
make a circle.
4. You take the long
black piece of paper
Stick it throgh the
circle and paste it down.
5. Then you take a
piece of string and
tie the string around the bat
6. Then on the other
side of the String you
put a paper clip it then
you put it on the ceiling

A Different Look at Dividing Fractions

Sally Herzberger

Are you concerned that your students do not understand why the divisor is inverted in a division problem involving fractions? Do you have students who can never remember which number is the divisor? Consider the following method for division of fractions as an alternate method of instruction when the traditional method fails.

If you have the problem: $\frac{1}{2} \div \frac{3}{4}$

Find a common denominator and solve the problem in the following manner:

Example 1:

$$\frac{1}{2} \div \frac{3}{4} = \frac{2}{4} \div \frac{3}{4} = \frac{2 \div 3}{4 \div 4} = \frac{2 \div 3}{1} = 2 \div 3 = \frac{2}{3}$$

Example 2:

$$\frac{2}{3} \div \frac{3}{5} = \frac{10}{15} \div \frac{9}{15} = \frac{10 \div 9}{15 \div 15} = \frac{10 \div 9}{1} = 10 \div 9 = \frac{10}{9} = 1\frac{1}{9}$$

Example 3:

$$1\frac{2}{3} \div 1\frac{5}{6} = \frac{11}{3} \div \frac{11}{6} = \frac{22}{6} \div \frac{11}{6} = \frac{22 \div 11}{6 \div 6} = \frac{22 \div 11}{1} = \frac{22}{11} = 2$$

This article is adapted from Melvin Zeddies' article "Creativity in General Mathematics", which appeared in the March, 1981 issue of The Mathematics Teacher.

Domino Puzzle

Annemarie Garcia

2	3	2	3	1
1	2	2	1	0
2	0	3	3	X
1	4	1	0	3
0	3	4	4	0
4	4	4	2	X

Materials: gameboard and a set of double six dominoes

Directions: Use the appropriate dominoes to fill up this puzzle.

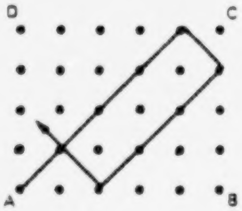
This activity is a bend of one brought to our Eighth Annual Summer Course by Jan Stanfield, Cornwall Education Centre, Redruth, Cornwall.

Starting Points

Colin Banwell, Ken Saunders, Dick Tahta

This page contains reprints of some problem cards from Starting Points (for teaching mathematics in middle and secondary schools). This excellent book, published in 1972 by Oxford University Press, is now out of print. We will make more ideas from this book available to you in coming SEEDBEDS.

REBOUNDS

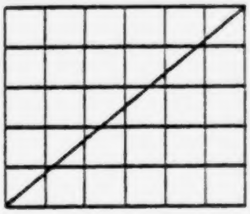


Make a rectangle of dots, *five dots* by *six dots*. Label the corners A, B, C, D.

Starting at A draw a line which goes diagonally across the squares until it reaches an edge. Turn through a right-angle and continue the line to the next edge. Go on doing this until you reach a corner.
Which corner did you reach?
How long is the line?

Investigate for various rectangles.

DIAGONALS



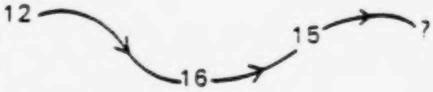
On squared paper draw a rectangle *five squares* by *six squares*.
Draw a diagonal of this rectangle.

How many squares does the diagonal pass through?

Do this for other rectangles.

Can you forecast the number of squares passed through if you know the length and width of the rectangle?

SUM OF DIVISORS



The set of divisors of 12 (*except 12 itself*) is:
$\{1, 2, 3, 4, 6\}$

The sum of these divisors $(1+2+3+4+6)$, is 16.
This is shown on the graph above by an arrow from 12 to 16.

By adding the divisors of 16 (*except 16 itself*) check that an arrow should be drawn from 16 to 15.

To which number should an arrow be drawn from 15? Continue the chain.

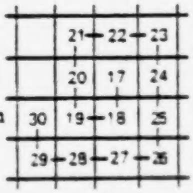
Investigate chains starting with other numbers.

PRIME PATTERNS

Write numbers from 1 to 100 in four columns.
Draw a ring around each *prime* number.
What do you notice about the primes. Can you explain why this is so?
Do this again using other numbers of columns.

1	2	3	4
5	6	7	8
9	10	11	12
13	14		

On squared paper write numbers from 17 to 100 in a spiral as shown.
Draw a ring around each prime number.
What do you notice about the primes?
Do this again starting the spiral with other numbers.



Experiment with other arrangements of numbers and see if the primes form a pattern.

An Old Game In A New Light

Anne Betscher

Since school began this fall, I have tried out several of the strategy games we discussed in our seminar. Most of the kids enjoyed them. The quicker kids liked them more than the slower ones did. One short-coming I have found occurs when a handful of kids figure out the best strategy. It seems that when this happens the others tend to give up and become passive participants - gaining little or actually losing from the activity.

But one game that all the kids enjoy that might require similar thinking strategies is Hangman. Hangman can be a thinking game or an at-random, guessing game and thus, can be enjoyed by all kinds of kids at the same time.

In Hangman there are good and bad guesses. Figuring there must be at least one vowel in every word, some fourth graders know that a vowel is a good initial guess. Letters that frequently occur in our language (i.e. r, s, and t) are also good guesses. Furthermore, as the word develops, certain letters are better guesses than others.

But all along the way there are scattered rewards for lucky guesses offered by those who have discovered no stratey. This aspect of the game makes it enjoyable for nearly all kids.

Perhaps, then, this familiar school game should rank right up there with our new-fangled problem-solving exercises.

WHO WAS HIS TEACHER?

Helen L. Miller

FACT: A child learns to walk before entering school.

QUESTION: Who was his teacher?

FACT: A child learns to talk before entering school.

QUESTION: Who was his teacher?

FACT: A child learns how to use the spoken language to communicate needs, desires, and information before entering school.

QUESTION: Who was his teacher?

FACT: A child learns the difference between night and day, between summer and winter, between yes and no, between good and bad, etc. before entering school.

QUESTION: Who was his teacher?

FACT: A child can find the middle of a circle before entering school.

QUESTION: Who was his teacher?

FACT: A child knows which "half" of the candy bar is the biggest before entering school.

QUESTION: Who was his teacher?

FACT: A child learns how much is the "most" before entering school.

QUESTION: Who taught him how to reason this out?

FACT: A child knows that a car goes faster than a bicycle and that a car needs gasoline to run before entering school.

QUESTION: Who was his teacher?

FACT: Most children can show you how to make a tunnel or a bridge before entering school.

QUESTION: Did he need a teacher to learn this?

FACT: A child can build all sorts of things before entering school.

QUESTION: Did you or I teach him how?

FACT: A child knows that buttons are to be pushed, whistles are to be blown, a balloon will break or blow away, holes go down, wheels go around, etc. before entering school.

QUESTION: What other concepts has the child discovered without the help of a teacher?

FACT: A child is able to understand many concepts before entering school.

QUESTION: Should we not then as educators try to discover how the child has been able to learn these very abstract concepts? It is quite apparent, as one listens to what children are saying and observes the methods of applying these concepts that a child uses, that a great deal of meta-thinking is taking place. Long before the child has the verbal language he needs to express his thoughts he is doing very sophisticated abstract thinking and reasoning.

FACT: A child has been doing some very difficult mental reasoning before he enters school.

QUESTION: What can we as teachers do to build upon a child's capacity to accommodate and assimilate knowledge in order to make his formal education more productive?

A Number Song

Tim Morton

Come on and have some fun;
Somebody hit the number one.

Hi, Boo;
Somebody hit the number two.

He is he;
Somebody hit the number three.

Hi, make a war;
Somebody hit the number four.

Has anybody seen a hive;
Somebody hit the number five.

Hi, Bix;
Somebody hit the number six.

Have anybody seen my Uncle Kevin;
Somebody hit the number seven.

Does anyone hate anybody;
Somebody hit the number eight.

Hinne;
Somebody hit the number nine.

What's a hen;
Somebody hit the number ten.

Hi, heaven;
Somebody hit the number eleven.

Hi, elf;
Somebody hit the number twelve.

Tim Morton is a student in Helen Miller's afternoon kindergarten class at Logan School in Granite City. This song was composed by Tim with the help of a tom-tom. Each time the words, "Somebody hit the number...." is spoken, the drum is to be hit that many times. The only contribution made by the teacher to Tim's song was that she wrote down the words as Tim made them up.

Maps

Bill Brainerd

For this activity you need a classroom set of state highway maps. The objective of the activity is to get students thinking more conceptually about their state geography, and to improve their skill in estimating and calculating distances.

State highway maps have a list of state parks and a code system for locating them. Students are usually familiar with one or two of the parks, but are amazed to discover how many their state really has.

It can be an interesting activity for them because parks connote adventure and recreation. There is, however, a huge amount of information compressed on a state highway map. This activity sets up a situation that encourages students to become sensitive to colors, lines, scales, and codes. First, they must search out the location of the park and then decide on the best route to get there. They have to determine what county the park is in and calculate the approximate number of miles of driving required to get there. They are encouraged to estimate the mileage and then to check their estimate against the data.

One objective is that they should catch on to several different ways of calculating distances. Adding the numbers that appear between the towns is one way. Getting the distances between major cities off the special mileage chart and then adding the extra highway miles to the park is another. The scale 1" equals so many miles can also be used.

This activity can open up their eyes to the geographical variety of their state, acquaint them with the richness of information on a map and spur them to devise techniques of double-checking figures by using estimates and varied means of calculation.

Note: It would be interesting to see if the students could make maps - perhaps of the school, the neighborhood, the bus route, etc.

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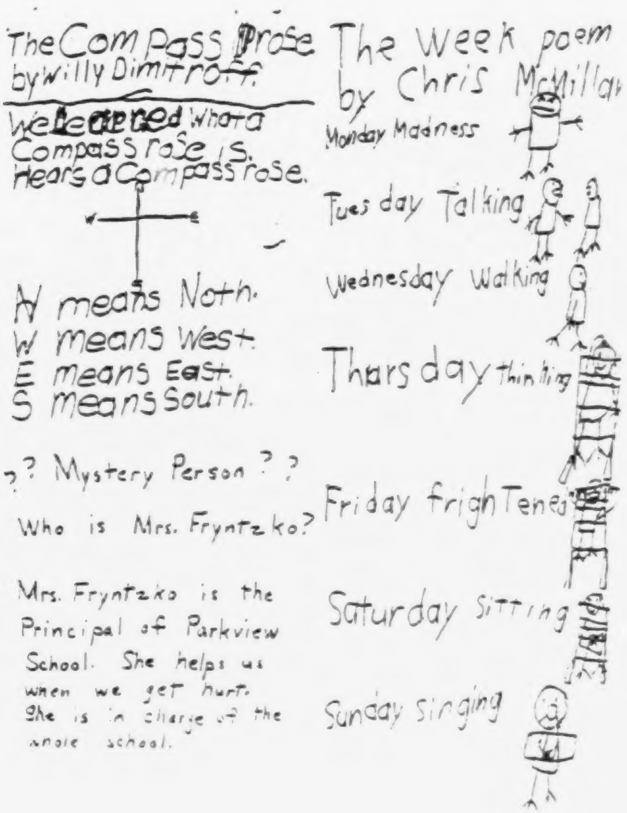


The Compass rose
by Willy Dimitroff.

We learned What a Compass rose is.
Hears a Compass rose.

N means Noth.
W means West.
E means East.
S means South.

?? Mystery Person ??

Who is Mrs. Fryntzko?

Mrs. Fryntzko is the Principal of Parkview School. She helps us when we get hurt. She is in charge of the whole school.

The Week poem
by Chris McMillan

Monday Madness

Tues day Talking

Wednesday Walking

Thars day thinking

Friday frighTened

Saturday sitting

Sunday singing

How A Child Reasons

Helen L. Miller

Teacher said, "Run over to the bookcase and get the red book, please."

I ran and she said that children should not run in school!

* * *

Teacher said, "Put your right hand over your heart as we recite the pledge to the flag."

I put my hand over my heart and stood very still, but teacher said to change hands because I was using the wrong hand. The hand that I had at my side was dirty and I did not want to put it over my heart. It would have been wrong to use a dirty hand.

* * *

Teacher said, "Do not touch the picture with your hands. Use your eyes."

It is very hard to touch something with your eyeballs!

* * *

This morning teacher said, "I'll help you in just a minute."

Now it is time to go home and I still don't know what to do. I'm still waiting for teacher. A minute must be a very long time!

* * *

Teacher said, "Mary, you have a nice picture with five balls all in a nice straight line."

There is a row of balls, but five looks like this:

0 0
0
0 0

* * *

Teacher said, "Let's have four at each table."

I sat down with all the other children, but she said there were too many; I would have to move. "But, teacher, the other children at the table are five and I am only four years old." Why did she say that I had to move?

* * *

Teacher said, "We are going to dye Easter eggs tomorrow."

Why does the teacher want the Easter eggs to die?

* * *

Everyday in every classroom, especially at the kindergarten level, one can see perplexed looks and concerned faces as the children struggle with language. How many times do we, as teachers, accuse children of not listening or of daydreaming because they do not immediately respond to our directions!

At the preoperational level of reasoning it is very difficult for a child to understand very simple statements that we, as adults, have understood for many years.

After many years of working with kindergarten children and after a summer working as a graduate assistant under Dr. O'Brien, I have found that children have a very definite system of logic all their own. It is not the logic of the adult mind, but it is something that the children use everyday in all areas of learning. It is not the adult logic used to prepare textbooks and workbooks that we use in the classrooms.

Would it not be far more "logical" to find out all we can about a child's logic and, based on a child's way of thinking develop textbooks - and workbooks if necessary - that will help the child progress from his system to the adult system so that we will be developmentally ready for him?

Do we not create more problems for the child by expecting him to work within a framework of adult logic that is almost impossible for him to grasp? The only reason for the child being able to cope with something that he can not "logically" accept is his blind faith in the fact that if the teacher said so, it must be right! As he matures and realizes that the teacher is only human and this blind faith falters, without a firm foundation of being able to reason and understand basic concepts, his whole structure of learning crumbles! No wonder we have children with learning disabilities and, later, school drop-outs.

There is so much to be learned about how a child thinks; there is so much work yet to be done. But why not start now! Each day in every classroom of every concerned teacher, there are very obvious indications of how a child thinks and reasons. Each of us by observing and listening has a great opportunity to learn more about children. Let's start now!

Dice Activity

Chuck Shelhamer

Although not an original idea, this is a good activity for small or large groups.

Students number a paper from 1-100. One person rolls a pair of dice. Each player makes as many combinations with the two numbers as possible and writes the equation next to the answer. For example, if 5 and 3 are rolled, the following combinations could be used and numbers covered:

$5 + 3 = 8$

$5 - 3 = 2$

$5 \times 3 = 15$

5 & 3 = 53

3 & 5 = 35

$5_{three} = 12$

$5^3 = 125$

$3^5 = 243$

(could not be used if using 1-100, although exponents work with smaller numbers)

Variation: Can all numbers 1-100 be covered using combinations of 2 digits 1-6?

Can You Make A Picture Like Mine Without Looking?

Pamela Masulla

I have used the following activity with my students and have found that it gives them good practice in listening attentively and in giving oral directions:

Prepare two or more envelopes (depending upon how many people will be participating in the activity) with identical contents of various colored paper shapes. Choose one person as the "direction-giver." (It may be a good idea to have the teacher be "it" the first time, as an example.) The "listeners" sit on the "direction-giver's" sides, facing the same direction. Place folders, or dividers between all players so that they can see only their own work. The "direction-giver" then begins making his picture, explaining each step in detail as he proceeds. For example, "Put the red heart on the table in front of you so that it's right-side up. Put the green clover to the right of the heart, with its stem pointing toward you; the clover does not touch the heart," etc. When the "direction-giver" is finished making his picture, all players take away the dividers and compare to see if their picture looks exactly the same as the "direction-giver's."

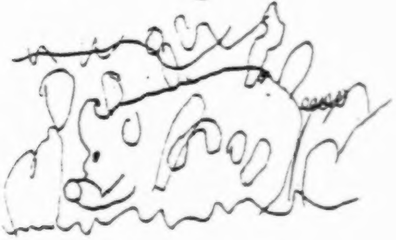
It is good to point out that there may be two reasons for the pictures not looking alike: 1) the "listener" didn't listen carefully, or 2) the "direction-giver" didn't give specific enough directions.

Let the players take turns being the "listeners" and the "direction-givers." This is excellent for developing listening and oral communication skills!

Note: What happens if the direction-giver faces the other players? Are the pictures still the same?

* * * * * * * *

the big pig words

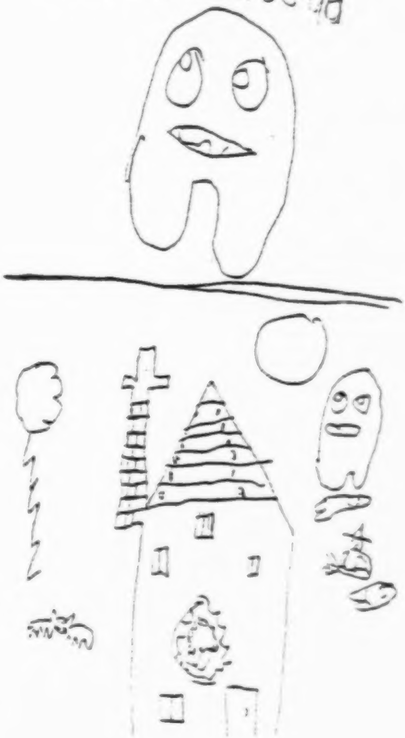


big pig fit
did swim six
dig win sit
hit

been

by michael Marlon

We made a haunted
house in School.
I was fun,
Patrick Thebeau



"ABCDEFGHIJKLMNOPQRSTUVWXYZ"

Helen L. Miller

Teacher said that we would learn to read. It looks so easy when she does it. Why does it seem so hard when I try to do it?

Teacher makes such funny sounds sometimes and points to marks on the chalkboard. I think she calls the marks alphabet letters. They must be important - there are so many!

Teacher seems so happy when Joey says all the letters without even looking. It's funny that Joey knows all those letters. But, you know what? Joey can't read either.

Teacher says that the sounds are important to know. I know the sound of brakes screeching, cars racing, TV, trains coming, grandpa snoring, and the baby crying, but I don't know how marks on paper can make a sound.

Teacher said that she would write down what we said about our trip to the zoo. She wrote everytime someone said something, but she left white places all the time. When we told her something about the trip, no one put holes in between the words. Wesaidthatwesawtheanimals andthefishandthebirdswelikedthemonkeysthebestandthebabyracoonandwehad lunchwheretherewerebirds

Teacher said the word for mother looked like this - Mother, and the word for father looked like this - Father. I am sure that my teacher is very smart, but I do not think that she means what she said. My daddy is much bigger!

Teacher asked us to write some words yesterday. One of the words is grandfather. She was not happy with me because I said I could not write that word. Maybe she doesn't know that my grandfather died.

I like my teacher very much. She is nice. Today I wrote her a letter because I love her. She asked who had been scribbling. I didn't raise my hand. It looked just like the way she writes when she gets a note from the office and I know what my note says. Why doesn't she?

Teacher said that these words are very important words:

is, are, am I, to, off, on, in, he, we, it

Teacher must be teasing. Those words are too little to be something that you can read.

Teacher read a story to us about an elephant, The words she said did not go with the pictures. There were ducks and birds and grass in the picture, but she did not say, "ducks, birds, or grass."

Teacher said that it was fun to read! She says such nice things when she shows us the pictures in a book. I want to read all by myself. I will try very hard to understand what teacher is saying and remember it!

There I've put on my thinking cap. What did she say - "a", "k", "b". . . . Oh well, I'll try harder tomorrow!

How Should Humans Pay Their Way?

Lewis Thomas

We like to think of ourselves as the most special things on earth, uniquely endowed with intelligence and awareness, the owners and operators in charge of the place, but this is a notion we will probably have to outgrow. If we try to hang onto the view too long we run the risk of not outliving it. We cannot survive indefinitely thinking of the earth as a kind of combination domestic animal and kitchen-garden placed at our disposal for consumption, by luck or providence. We are obliged, like all other living beings, to pay our way.

The challenge confronting us at this stage in our development is to discover what is meant by paying our way. Perhaps we are too young as a species -- having arrived only moments ago in evolutionary time -- and no doubt we have a great deal to learn. This is, I believe, the underlying purpose of science, for many of the things we need to learn concern the way the whole place works, from the inner parts of individual cells to whole organisms, then coral reefs, rain forests and cities like London, Tokyo and New York. We are the brainiest of animals, perhaps indeed the only species on the planet in possession of consciousness, but for all our frontal lobes we have an enormous deal to learn.

Come to think of it, I am not all that sure we are entirely unique in the matter of consciousness. There is an extraordinary insect known as the weaver ant, which lives in huge colonies scattered over acres of forest trees, each family within rolled-up leaves which they convert to sheltered fungus farms by first tugging the edges of a leaf together and then, holding larval ant like a shuttle, binding the leaf surfaces by an adhesive protein elaborated in the larva's spittle. Now, the weaver ants do a lot of foraging, venturing out in platoons into other trees and across the ground, bringing back odds and ends of edible things, but always aware of the precise boundaries of the colony's territory. When a group of ants of one colony encounters an alien ant within its territory, even another weaver ant of the same species but from another colony, an extraordinary defense reaction occurs. Some of the defenders rear up on their hind legs and make threatening gestures, while others run back to the colony's center to get help, leaving trails of scent along the route so that they can find the way back without fail. Within a few minutes a whole army is recruited in this way; the signals indicating invasion are conveyed by the messenger's posture and headwaving, and the direction is clearly marked by the scent.

Well, one way to look at this behavior is to dismiss it as entirely automatic: the ants are little encoded machines, the individual parts-on-legs of a larger computer, the colony, but nothing more. But another way to see it, fair enough so far as I can see, is as the carefully thought-out response of very small animals endowed with very small brains, nothing at all like ours, incomparably tinier, only a few strands of nerve fibers connecting a sparse array of ganglia, maybe capable of giving rise only to one or two very small thoughts, but thoughts nonetheless, same as ours. Our trouble may be that our brains are extremely large, constantly extruding great masses of thought all the time, long strings of sequential thought, complex fugues of thought, and we are, therefore, unable to imagine what it would be like to think only one single thought, like a flea, or two or three thoughts at a time, like a weaver ant. The mind of a single insect contains no lessons for the human brain.

But consider what comes into play when a half-million or a million ants are assembled in a colony, in constant motion, exchanging messages and single bits of information, always touching each other, as coherently connected as the ganglia of a huge central nervous system. It is what biologists used to call a *superorganism*. An anthill and a termite colony can be viewed as structures with some of the properties of a cerebral cortex, capable of calculating with precision the ventilation engineering needed for maintaining optimal temperature and humidity for the whole colony, and estimating the distance and direction of remote sources of food. The colony can live as long as a turtle, even though each individual member has a life span of only a few weeks. A single honey bee is nothing more than a sparse string of nerve cells on wings, but the whole hive can solve equations in solid geometry and trigonometry all day through, finding sugar by knowing exactly where the sun will be an hour from now.

Human society is not like this at all, of course. We do a lot of things together, build cities, for example, and swarm into and then out of them, but we are not bound by our genes to keep doing the same sort of thing over and over again, generation after generation. We have risen above the social insects long since, thank goodness. We can change our minds, think up new ways, imagine different futures, even wander away from time to time. Still, we are bound to each other, by language, by music, by affection, most of all by our curiosity about each other and about the world at large.

It is not enough to pay our respects to the earth, pasting the latest photographs from satellites into our family albums, remarking on its dazzling progress from what must once have been a single clone of single-celled bacteria to such an exuberance of complex life tumbling about over every acre of its great surface today.

Very likely, we have obligations. Human society is as much a working part of the planet's collective life as any other part, but what are we good at? Could it be that we are a transient tissue, something being tried out for a role in evolution, here today but gone tomorrow? I doubt this, partly because I wish to doubt it, but also because I believe that nature makes sense in every natural enterprise that science has thus explored in any depth, and I am inclined by this bias to the view that our species will make sense as well.

What we need is time: time to figure things out, to learn more about the life in which we are ourselves a swarm; time, above all, to grow up as a species, to begin thinking together as a species, at least as cleverly as weaver ants and termites. The difference for us is that we will be obliged by our very nature to worry about more than our own isolated colonies; it is up to us, if we are to become an evolutionary success, fit to fit in, to become the consciousness of the whole earth. WE are the planet's awareness of itself, and if we do it right we have a long way to go.

It is the tendency of life to survive by propagating and to extend itself into any new niche that it can find. Even in the rocks dug from remote depths beneath the Antartic ice, there are living creatures, as much alive as roses only different in their structure. The near-to-boiling water of geothermal springs contain living cells that can only survive and propagate at that temperature. There are forms of life that live off pure sulfur. Viruses make their living by becoming parts of the genetic material of other cells. Certain bacteria can insert their own DNA into the chromosomes of the plants in which they live, changing their environment by the same technology we use for making interferon by recombinant DNA. There is no limit to the ingenuity of nature on this planet.

Perhaps we will land and set up households on other planets someday, even build ourselves mobile cities in plastic domes to travel elsewhere in the galaxy, tacking our way to the edge of the solar wind, gardeners for our part of the universe.

When people from my profession talk like this, it is sometimes called hubris. Science is thought to be a process of pure reductionism, taking the meaning out of mystery, explaining everything away, concentrating all our attention on measuring things and counting them up. It is not like this at all. The scientific method is guesswork, the making up of stories. The difference between this and other imaginative works of the human mind is that science is then obliged to find out whether the guesses are correct, the stories true. Curiosity drives the enterprise, and the open acknowledgement of ignorance. The greatest single achievement of science in this most scientifically productive of centuries is the discovery that we are profoundly ignorant; we know very little about nature and we understand even less.

Starting with ourselves, and the life immediately around us, we have lots of homework to do, lots of pride to swallow, lots more ignorance to face, some of it only sensed out of the corner of the eye. But I think we can make a guess at one kind of answer to my question: what are human beings good at, really good at as a species, making us worth all the trouble we cause? For the very long run, if we are to have a long run, learning is what we are good at, and if we keep at it long enough we may one day begin to pay our way.

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*This article is reprinted in its entirety from The New York Times, Monday, August 24, 1981.

Mystery Picture Booklet

Marjorie McEnany

Sometimes children aren't as aware of their surroundings as one may assume they are. Having them compile a mystery picture booklet is one method of encouraging awareness.

The Looking Book by P.K. Hallinan is a good introduction to the lesson. In this book the children are told to put on their "lookers", glasses without lenses, and examine the world around them. The children in the story are surprised at all the ordinary, marvelous things in the world.

After listening to and discussing the book, the class is asked to make a booklet of mystery pictures. Each cuts a picture of a familiar object from a magazine and pastes it on a sheet of paper. They write the name of the object and words describing it beside the picture. Each places a sheet of construction paper over the first paper and cuts an inch or two inch square revealing just that much of the picture. The booklet is put together by placing metal rings through holes punched in the top of the papers.

The students enjoy guessing what the pictures are by looking at the small portion revealed and then listening to or reading the words which describe it.

Counting, Ad Infinitum. . .

Linda McDonnell

One old activity that my classes would do after learning to count to 100 was to try to be in the 1000's Club. The membership was limited to those children who, after pages and pages of numbers (which I checked), countless pencils, and very tired little fingers, finally reached 1000. Some children even went beyond--although not far beyond and less enthusiastically.

I used to think this was a neat activity. But, again, certain words kept popping up in my mind--boring! tedious! let me out of here! I decided to do it differently. How about the same numbers, but this time make it a class effort?

So, I got out some perforated computer paper that can be extended and the children started counting. So far, our numbers reach across the front of the room. The children are very excited to see how far we can count as a class. But the children know that we can never come to the "biggest" number, because even the biggest number can be increased by one more on the next page of our computer paper.

Calendar Computation

Martha J. Lewis

This math activity gives students practice in computation and observation of number relationships. A calendar of any month will work.

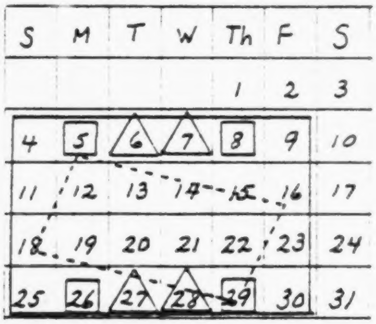
Begin by drawing a rectangle on a calendar month, using six numbers on each of the horizontal lines and four numbers on each of the vertical lines (see calendar example). First, add the vertex numbers - the four corners. In the example the sum is 4 + 9 + 30 + 25 = 68.

Have the students look for other sets of four numbers that are within or on the rectangle and have the same total as the vertex numbers. As an example, point out the four numbers marked by squares (5, 8, 26 and 29) equal 68. Another example is marked by triangles (6, 7, 28 and 27). These sets were obtained by moving "in" the same number of steps from each side of the rectangle.

The students will soon discover they can find new sets totaling the vertex sum by starting at the corners and "compensating" for each move: two down from the top left corner means two up from the bottom right, etc. Have the children see how many they can find.

This activity can be used with different months and various size rectangles. The sums of the vertices will change, but the concept remains the same. A fun way to recycle your old calendars.

October · 1981



S	M	T	W	Th	F	S
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

How Many Gumdrops Can You Put in an Empty Jar?

Fred M. Hechinger
Of the New York Times News Service

Fear of mathematics has become something of a cliche and an excuse for failure, or for avoiding the subject altogether. In the latest attempt to deal with the problem, a group of educators from Harvard University and Milton Academy, a private college-preparatory school near Boston, published a special student text and teacher's guide to help pupils develop the proper study skills before they embark on algebra, that first of a succession of mathematics hurdles.

The HM (Harvard-Milton) Math Study Skills program comes with the benefit of two years' experience in another area. In 1979, the same group published a general "how to" study guide for middle-school pupils, with the stress on reading and writing. According to its authors, it is being used in more than 10,000 schools and has recently been translated into Spanish. Its success, they say, inspired them to move into mathematics.

In its introduction, the student text asks: "How many people do you know who say 'I can't do math' or 'I hate math'? Most of these people really can do mathematics. Yet they've become afraid of it because they don't know HOW to learn mathematics."

The guide, says Catherine D. Tobin, its author, is not intended to replace any mathematics texts, but to get students started on the right foot. Students who have a background in study skills, she explains, can begin to become independent learners. "I look on the guides as a key to let them find the information on their own," she adds.

Tobin, herself an experienced mathematics teacher, stresses that classroom teachers need not follow the guides page by page. "Many are already doing some of this," she said. "They may pick and choose and add their own ideas. It's a starting point to build on."

Major topics covered in the guides are: listening as a mathematical skill; problem solving; understanding the language of mathematics; learning from homework; formulas; estimation; preparing for, and taking, a math test.

As a start, the guide underscores the importance of careful listening. The teacher asks questions (like the following) with a hint that most of them are, in fact, riddles:

If it takes three minutes to boil an egg, how many minutes will it take to boil three eggs? (Three minutes if you boil them together.)

How many gumdrops can you place in an empty bottle? (One. After the first, the bottle is no longer empty.)

In another listening exercise the teacher gives an example that sounds very much like a typical math problem but lacks one element:

A school trip costs $29,728. How much did it cost per student? (Missing: The number of students.)

Introducing the student to problem-solving techniques, the guide asks: How many parts does a piece of paper have when it has been folded in half 10 times? Then it tells the students that problem solving is not a mystery but a way of thinking that can be learned, and that most problems are not solved by just reading the problem and then doing a calculation. The trick is to organize the information.

To solve the paper-folding problem, the guide suggests making a simple table, with 10 lines. Each line indicates the number of folds and the number of resulting parts, beginning with one fold and two parts and continuing with two folds and four parts. That way, the tenth line, or tenth fold, shows 1,024 parts.

Out of this exercise, as with most problem solving, emerges a pattern. In this instance, the pattern is that the number of parts doubles each time another fold is made. This introduces "a power of two," meaning that if the paper is folded seven times, the number of parts is two to the seventh power, or 128, and so forth.

Another problem-solving examples asks, "John was five years old when his father was 41 years old. How old will John be when his father is four times older than John?" One way to organize the information is to draw parallel boxes with the top designating John's age and the bottom his father's. Starting with five on top and 41 on the bottom, the student fills in the two ages for each successive year until he reaches 12 for John and 48 for the father, which is the correct answer.

In the chapter on understanding the language of mathematics, the guide makes the point that every activity has its own language, such as music (note, song, harmony, scale, and so forth) and baseball (hit, run, out and steal). Learning the language of mathematics from the start rather than just memorizing terms without really comprehending what they stand for is therefore crucial, and the guide leads the student to the proper use of glossaries and dictionaries.

Some of the sections may seem elementary and a bit preachy, for example, advice on the value of homework and the best conditions under which to do it: without stereo or television, sitting upright at a neat table or desk with all the necessary equipment, working for a period of 25 to 45 minutes and then taking an "active" break that relaxes the mind. It is hard to quarrel with the sermon's message, but it is questionable whether preaching is the best way to reach adolescents.

Still, such flaws are overshadowed by the useful information contained in subsequent chapters on how to deal with charts and graphs and how best to prepare for and take tests.

There are techniques that can make a difference on tests, particularly in dealing with multiple-choice questions. For example, if you don't know which answer is right, cross out all the ones you know are wrong. Then, pick the most likely answer from the remaining choices. If you still aren't sure that any of those looks like the right answer, the guide says, make a good guess "unless your teacher tells you not to guess."

Closely related, and among the most useful sections, is the chapter on estimation. Old-fashioned parents probably cannot recall ever having been taught to estimate or to aim for anything but the one and only correct answer. Today, estimation is a crucial mathematical skill, not only to cope with multiple choice tests but to catch absurd errors which have become part of a world dependent on poorly managed computers. When the bank book records an absurdly low interest entry the consumer is best protected by the skill of estimation.

The HM Math Study Skills program is endorsed by the National Association of Secondary School Principals and the National Council of Teachers of Mathematics, who consider it a followup to their Agenda for Action, recommendations for the improvement of mathematics instruction published last year. Good teachers and bright students may view some of the guide's contents as old news for their own study habits; but field tests have shown that these are the lucky few. Considering that mathematics, along with foreign languages, is probably still the most poorly taught subject, the guides deserve praise rather than criticism for being basic and simple. For information and orders write to NASSP, 1904 Association Drive, Reston, Va. 22091.

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*This article is reprinted in its entirety from the Bellevile News Democrat, Wednesday, September 9, 1981.

Pico-Fomi

Pamela Masulla

The object of the game Pico-Fomi (pīcō-fōmī) is for the "detective to determine the "leader's" secret 2-digit number. First, a "leader" chooses any 2-digit number, keeping it secret. The "detective(s)" begin by guessing a 2-digit number. The guess is recorded on paper or on the chalkboard for all to see. If the 2-digit number contains none of the numerals in the "secret" number, nothing is written beside the "guess". If the "guess" contains one of the numerals in the "secret" number, but it is in the wrong place, the "detective" receives a "fomi" (F) beside that "guess". If the "guess" contains two of the numerals, but they are in the wrong places, the "detective" receives a "fomi-fomi" (FF). If one of the numerals is correct and in the correct place, the "detective" receives a "pico" (P). When both numerals of the "guess" are right and in the right places, the "detective" receives a "pico-pico" (PP) and has determined the "secret" number. The "detective" then becomes the "leader".

Following is an example of a game where the "secret" number is 74:

"guesses"	"clues"
18	
42	F
24	P
64	P
34	P
54	P
74	PP

Variation: This game could also be played with 3-digit, 4-digit, or larger numbers.

Mind Images and Special Effects

Don Larson

Many of us have vivid dreams or special ideas of how something we read about should look. As we saw in the recent seminar, no two people interpret a certain stimulus the same; yet, it appears to me that society and schools put a certain pressure on the individual to respond in a way similar to that which everyone else would.

Schools attempt to "teach" us to survive in the world by stripping us of any individuality or free thought, and putting us into a mold which society will approve. Those whose ideas are too good are outcasts for being "eggheads" and those who are not so smart are outcasts because they don't measure up to the standards of the society.

Most of the jobs we find today fit into these molds except for the Special Effects Person of the movies. All of the most imaginative writings -- Jules Verne or Edgar Allen Poe can be brought to the eye via the special effects person. This person has free reign to think and do as no one has before or ever will.

Why settle for two people talking on a screen when stop action photography, expert model makers, and zoom lenses put you into battles with skeletons or Medusa, on the back of Pegasus or astride a flying carpet with your own Genie flying next to you. Battles below the sea or among the stars are an everyday thing in the land of special effects.

Since not everyone can be into special effects, the schools do their job by turning out millions of every-day-Joes. Thank heaven that there is still a refuge for these creative genuises and their minds' eye images.

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What to Do?

Anne Betscher

I was alerted and mentally stimulated by the value of thinking and problem-solving stressed by the facilitators of our seminar. But I sincerely worried about losing this insight. Why? I couldn't see how to really use it. I found scattered, fleeting applications, but nothing solid. You weren't practicing what you were preaching. You failed to set-up a situation in which I could assimilate your ideas. I had no mind-frame into which I could plug these concepts. I assigned them value so I made an effort to force accommodation. I had an interest, a curiosity, but no way to store this information. I had no clearly-understood need for it. My struggle to hold it demanded written record. ... Now I know why kids need paper and pencil to do math.

TO'B's Note: Right, Anne. The week's summer course was only a start and we had no hope (or desire) that all would be fitted into place in a short time. What we wanted to do was to plant some seedlings, many of which -- we hope -- will grow during the next few years. Too many things are quick fixes. Thanks for hanging in with us. (Anne continued with a group in Greenville that started in September.)

12345679, A Fascinating Number

Bill Brainerd

Here is an activity in multiplication using the number 12345679 as the multiplicand. This activity lends itself to experimentation on the part of the students, and sets up possible discoveries by them.

A variety of strategies could be used such as practice at the chalkboard or practice in using calculators. The objective, however, is less in manipulation, but rather the stimulation of curiosity about the mystique of number combinations.

Multiplying 12345679 by multiples of nine results in products that are all 1's, or 2's, or 3's, or 4's and so on up to the product of 81 times 12345679 which is 999,999,999.

The student's surprise is further compounded when the student discovers that 12345679 times 999,999,999 equals 12,345,678,987,654,321.

All of the data thus far I discovered in two different sources, one of which I have lost track of. The data that follow, I worked out on my own.

This includes the observation that 12345679 when multiplied by 3, 6, 12, 15, and 21 results in products in which trios of digits are repeated. The results are 37,037,037; 74,074,074; 148,148,148; 185,185,185; and 259,259,259 respectively. I have not tested whether or not this kind of configuration continues on with the multiplies 24, 30, 33, 39, 42, and so on.

Finally I noted that when 12345679 is multiplied by other numbers such as 2, 4, 5, 7, 8, 10, 11, 13, 14, 16, 17, 19, 20, 22 and 23, in every case every digit in each product is different. For example, 23 times 12345679 equals 283,950,617.

There may be an explanation why the 12345679 produces all these startling results. From my point of view, however, the important objective is to have some fun in discovering one of the countless enigmas of mathematics. It might promote investigations of other mathematical entities such as Pascal's triangle, for example.

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Listening vs. Other Channels

Pamela Masulla

In our class with Dick Tahta and Tom O'Brien, we discussed the importance of developing listening skills along with some methods and activities to aid in attaining these skills. Since that time, I ran across an interesting bit of information in Language Arts Activities for the Classroom, by S.W. and I.M. Tiedt. I'd like to share it because I think it addresses these issues.

"We listen more often than we speak, read or write:
We listen a book a day.
We speak a book a week.
We read a book a month.
We write a book a year."

What's Next?

Ed Graves

A problem that many of us brought up again and again during the course with Dick Tahta and Tom O'Brien was how to use the ideas we had as a result of our work. How could we incorporate them into our classroom schedules, especially in a schedule of departmental classes with several teachers involved?

I've found that a corner or table at the back of the room with materials and idea cards solved the problem nicely for me. Whenever a student has some free time, he may go to the table to choose a project or to work on one he has already started. I ask that they keep notes and write up their findings in some way to share with the class.

This sharing has started some good thinking and opened the door for more discovery. One of the big problems all have had to face is writing up their findings. Most can explain orally but have difficulty in putting their findings on paper. A group of students were recently working with the game called "Tax Man". They found what appeared to be a pattern to always beat the "Tax Man". They could show the class what they found, but had great difficulty in putting this into written form. So what we've been calling a "math project" is also in a sense a "language project". And so the students can use various disciplines to accomplish their work. Where can we go from here?

Some Observations for Education

Thomas C. O'Brien

Here are some thoughts that have been kicking around in my mind for a year or so. Now that they're on paper, readers might want to comment and bend.

Small Observation 1

A year ago the municipal authorities cut down a sycamore tree at curbside in front of my house. The tree was diseased, they said. The stump they left was flush with the ground.

Today I was surprised to notice green leaves, knee-high, where the tree had been. "What have you planted there?" I asked my wife. "Nothing," she said. "That's the old sycamore tree." Indeed, seedlings -- a bush of them -- had risen from the ground level tree trunk.

Small Observation 2

Today's observation brought to mind a visit to a friend's cottage in Suffolk, England, some time ago. The cottage abutted an abandoned World War II American airfield which was, in the words of the local folks, "going to corn." My children and I had a grand time bicycling down the crumbling landing strips, exploring the falling down dormitories (on one wall we found "P.J. Smith, Toledo, Ohio, 10 missions to go." Whatever happened to P.J. Smith?), and trying to reconstruct what this place must have been like in 1944 -- the madness of war, the tension that preceded missions, the furious pace, the damage, the death.

On a sunny August afternoon, thirty-six years later, all was quiet. The corn had all but taken over. In ten years, it seemed, there would be almost nothing of the airbase left to stir the imagination of a World War II buff and his children.

Small Observations 3 and 4

I do much of my best thinking in barber's chairs and on airplanes. Sitting in a barber's chair recently, I found that I had read all the magazines and had nothing to do but look out the window. What was visible, given the tilt of the chair and the slice of window available to me, were two trees. They were both poplars and, I suspect, they were planted at the same time. It's a good bet that both trees were subject to the same soil conditions, the same amount of rainfall, and similar levels of whatever else poplars deem important. Yet the trees were very different in size and shape. (To be sure, neither looked like a lilac bush or a dachshund; it's just that they were by no means carbon copies of one another.)

At another time -- in fact, on many occasions -- I have delighted in flying over the American southwest. I am always struck by the same thought: God must have been very angry when He/She made this place! What a beautiful, tortured, exciting landscape it is!

Two things are particularly striking to me, and the ideas recur on every trip. First is the non-linearity of the landscape. Rivers and riverbeds, for example, are easily distinguished. I am a New Yorker and streets there run north-south and east-west with only a few exceptions (Broadway south of Fourteenth Street is one). The rivers -- rivers in general -- create the most exceptional, meandering paths. So do trees and treelines and desert plants. They fan out, branch, wander. They have a logic of their own.

The second thing that strikes me is the regularity of human-made elements in the landscape. I am always shocked by the circles -- often green circles -- that I see from 35,000 feet. I once asked a stewardess what they were. "I don't know. I'll phone the pilot." Come to find out, the circles were the outlines of irrigated fields. A central sprayer irrigates acres of land just as a hose spinner waters my lawn at home. These circles can be the only geometrically regular part of the landscape for hundreds of miles.

Elaboration of Small Observation 1

Organic entities are difficult to stifle, municipal tree committees notwithstanding.

Elaboration of Small Observation 2

Inorganic entities are overtaken by organic entities.

Elaboration of Small Observations 3 and 4

Nature is not a cookie cutter. Organic entities, wherever they fall on the phylogenetic scale, differ from one another even when internal and external influences stay constant. (Note 1)

The development of organic things is not "neat" to the casual eye. The "neat" things — you can usually spot them immediately -- are artificial (in the true sense of the word). That's not at all to say that organic development is random, nor is it to say that neatness is, per se, inappropriate.

About Education

Much of education views the human mind as inorganic. It is a "memory bank" or a storage bin. Worse, knowledge itself is widely viewed as inorganic. It is "stuff," static and unchanging.

An alternate view is much more sensible. The mind of man is organic. Casual observation alone is sufficient to show that the "memory bank" view is inappropriate: we dream, we imagine, we predict, we wonder, we invent. We generate problems and we solve them without having first memorized a handed-down solution.

Just as important, knowledge itself is an organism. It grows as a plant. (Is your idea of family or of literature or of vacation the same as it was ten years ago? How did it develop?) To say that knowledge is an organism is to be very bold, but this notion summarizes to some extent the fifty years of research of the Swiss philosopher/psychologist Jean Piaget, who toward the end of his career used the word "organelle" (small organ) to describe mental constructs. (Note 2)

Given the organic nature of mind and of ideas, there are three aspects of organisms I wish to address.

1. Organisms require nutrition. Should education be seen as nutritive and developmental rather than custodial and additive?

2. A major characteristic of organisms is their tendency to survive and to conserve both for the present (fleeing or fighting against danger) and for the future (storing food for the winter). Should education help children to conserve in the present -- to construct who they are, what they stand for? Should education help them to survive in the future -- to deal adequately with novelty, to know the real basics in a situation, to solve problems for which no cookbook solution exists? (At the most practical level, it makes sense to prepare children

for the future. By 1990, I have heard, 50 percent of the jobs in the American workplace will be jobs which do not exist now.)

3. A third dominant characteristic of organisms is that they tend to produce new organisms. Should education encourage children to produce new ideas? To be sure, there's an important balance to be kept between conserving old ideas (lest we fly to pieces) and creating new ones (lest we not fly at all). Right now, the balance in education is way off center. (Note 3)

Final Comments

Organic development, especially the development of the human mind, is by no means random. Piagetian research, widely replicated, suggests that thinking tends toward organizing. Thinking tends toward stability, coherence, economy, and generalizability at the same time that it seeks the new and the unknown. What is education from an organic perspective? It is systematic intervention to promote children's construction, coordination, differentiation, and the elaboration of ideas. The British educator, Brearley, puts it well:

> The main work of the school is surely the fostering and developing of mental life, enabling children to experience more fully and consciously all that life has to offer. This large overall aim is to be achieved by an infinity of small steps. The material we provide can seldom be thought of as an end in itself but rather as a means through which effective thinking and feeling are fostered.[1]

Notes

1. For organisms low in the phylogenetic scale, much of life is dominated by genetic transmission. The higher one goes, the less this is so; constructions in interaction with one's environment seem to carry the major burden. If two trees, side by side, are far from identical, how reasonable is it to expect that two humans--schoolchildren--would (or should) be identical?

2. It may be that a "map" of an idea--of family or of literature or of vacation (or of Richard Milhouse Nixon, for that matter)--looks much more like a map of a river or a tree than of a superhighway. It is fitting, given what we know of neural circuitry, to think ideas as networks rather than straight lines or brick walls.[2]

3. "[The] essential abilities for intelligence are certainly:
to respond to situations very flexibly;
to take advantage of fortuitious circumstances;
to make sense out of ambiguous or contradictory messages;
to recognize the importance of different elements of a situation;
to find similarities between situations despite differences which may separate them;
to draw distinctions between situations which may link them;
to synthesize new concepts by taking old concepts and putting them together in new ways;
to come up with ideas that are novel."
--Douglas R. Hofstadter, Godel, Escher, Bach: An Eternal Golden Braid, New York: Basic Books, Inc., 1979, p. 26.

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[1] Molly Brearley et al., The Teaching of Young Children: Some Aspects of Piaget's Learning Theory. New York: Schocken Books, 1970, p. 7.

[2] Scientific American, "The Brain," August, 1979.

Problem Number Game

Marie Reeves

Children can have fun with computation as they use number facts to help them discover a certain number.

Players: 5 to 12

Materials: Pencil and paper for each player

Game Procedure:

1. Players sit in a circle.
2. A player begins by asking for a number that is more (or less) than a given problem's answer. For example, "I want a number that is more than 7 + 4."
3. The next player asks for a number that is more (or less) than a given problem's answer, but his answer must also meet the first player's requirement. For example, "I want a number that is less than 3 X 6 (it is possible to find a number that is less than 3 X 6 and more than 7 + 4 as previously required)."
4. Each player asks for a number in problem form that does not conflict with previous players' requirements.
5. The game continues until there is only one possible number or until an error is made.
6. The first player to find one possible number wins the game.
7. Upper and lower limits to the game should be established. After the game has been played a few times, players should be encouraged to play without paper and pencil.

Parents Help Foster Urge To Learn in Young Children

Deborah Churchman

Home environments, no matter how poor, are a citadel of care and concern for children.

All parents intrinsically possess the abilities to help their child succeed in school.

Schools should start with what the family has instead of worrying about what it doesn't have.

The Home and School Institute, a national nonprofit organization that urges the development of parents as "their child's most important teacher," is based on these three "nondeficit" ideals.

Said the institute's founder and president, Dorothy Rich: "Even the poorest homes -- and believe me, I have been in some truly poor homes -- have the most essential aid to learning. They care about their child."

Rich, a woman with the warmth of a grandmother and the directness of a teacher, reached these conclusions in the late 1950's. As a high school English teacher in New York City and suburban Washington, D.C., she saw students having "difficulties they didn't need to have, in grammar or spelling -- the basics."

Looking into it, she discovered "the high school teachers said it was the rotten junior highs, and the junior high teachers said it was the rotten elementary schools. The elementary teachers of course said it was obviously the home background."

Then, as a mother of two children, she saw "the wonderful urge to learn in young children. These were the days when we were told, 'Don't teach your child, let the professionals do it.' But I started to teach mine anyway."

Following the leads of Rose Kennedy, Ida Eisenhower, and the mothers of Pablo Casals, Frank Lloyd Wright, and Booker T. Washington, Rich taught her children to read, write, and do simple math problems at home. The results, she felt were worth repeating.

So in 1964 she founded the institute to encourage parents who believe strongly in the possibilities and achievement of their children.

Working with fellow educators and parents, Rich developed a series of "deceptively simple" recipes parents can use to teach basic reading and math skills "in conjunction with schools -- we do not advocate taking the child out of school," she underscores.

Using everyday objects found in the home and community, family teams sort the laundry (categorizing - a pre-reading skill); get cost estimates for needed items over the telephone (math and reading); make maps of the neighborhood (writing, geography); investigate and chart the home's water system (writing, science); and put toys away (more categorizing).

The results of families using these recipes prove that Rich is onto something. Her first stab at it -- eight recipes sent home to a few Washington D.C. first graders -- showed "statistically significant" gains in reading.

At another experiment in Benton Harbor, Michigan, the program compared favorably with a similar Title I remedial reading program. The Title I first graders, pulled out of the classroom for extra instruction, showed a 42 percent improvement in 1975 at a cost of $400 per student. The next year the schools sent home Rich's recipes with selected students, and the pupils showed a 54 percent gain -- at a cost of $4.31 per child.

Encouraged by these results, Rich had the recipes translated into Spanish to use in a large Los Angeles program and in inner city Washington, D.C. Then in 1978, with a grant from the Charles Stewart Mott Foundation, the institute expanded the recipes to include learning information for all family members - parents as well as teachers.

Initial results of this last effort are enough to impress any parent. Some 90 percent of the mothers and fathers participating in the program's field testing reported that their child could read and understand large numbers better. More impressive, perhaps, is the claim made by 85 percent of these parents: that their child can now follow daily routines without being nagged. What's more, 63 percent of the adults reported they had learned to share household chores as a team.

The recipes prompting these statistics are compiled in a book, "Families Learning Together," soon to be published by Simon & Schuster. But the ideas shouldn't stop there, Rich said. She urges families to add to and adapt these recipes to meet individual needs.

"No one can individualize learning like a good parent," she said. "Even the best schools can't do it - they don't have the time and cannot know your child the way you know him."

Asked what she thinks really underlies the success of this approach, Rich said frankly, "Look, these are nonthreatening games the parents can play with the child. Really, it's a way for the child and parent - or grandparent, older sister, day-care sitter, whatever - to get together and show that they care about each other. And that's the key."

Here are a few "recipes" that show how the Home and School Institute uses a common community resource - the grocery store.

"Don't worry about doing anything wrong in this home teaching. You can't do it wrong and neither can your child. Be imaginative. Use your own ideas to make the activites even more enjoyable for your family," said Dorothy Rich, president of the institute.

Making Grocery Lists

For a pre-reader, cut the labels from four or five items you need to replace and glue these on a piece of cardboard. This is his "shopping list" - he should look for these items in the store.

Ask your child to take a poll on a food product the family is using. Help him take notes on why people like or dislike the product. Talk about the results at the dinner table.

List the jobs that go into preparing a meal. Your list might look like this: Planning the meal. Shopping for groceries. Preparing the food. Setting the table. Cleaning up afterward. Ask each family member to choose one job on the list. Estimate how long the job takes from start to finish (the total time it takes to do any job equals 100 percent.) Divide the list to see what part or percent of the total time each job takes.

At The Store

Let your child call out the prices of items you place in the cart.

Choose four or five product items to weigh - onions, potatoes, peaches, apples, and so on. Help your child weigh each of the items separately. Which weighs the least?

Help him choose a piece of fruit to take home and eat. Let him weigh it and estimate its cost, and then pay the cashier.

Look at how items are placed on the shelves and in the display cases. Ask which kinds of items are together. Ask why he thinks these products are grouped in certain ways.

If the store has a credit application, obtain one, and have your child fill it out - just for practice.

At Home

Starting with one shelf, talk about the best way to organize it. Which would be more helpful - to organize cans by size? To put all the short ones together, all the vegetables together, all the boxes together? When you and your child have decided, do the work as a team.

Save a week's worth of cereal boxes, soup cans, and laundry supplies. Together, look carefully at each container, reading the price aloud. Ask him to put all cans and containers that cost 50 cents or less in one pile, all those that cost from 51 cents to $1 in another pile, and make a third pile of those costing more than $1. Talk about the differences.

Look at a food label together. Find the list of ingredients, and ask him to read them. Have him list the ingredients that do not sound like food -- sodium nitrite, ascorbic acid, others -- and talk about additives. Ask your child to count the food ingredients and then to count the nonfood ingredients on a label. After looking over several food products, ask your child to name the products that contain the most additives.

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*This article is reprinted in its entirety from the Belleville News Democrat, Wednesday, October 21, 1981.

Playing "Catch Up"

Martha J. Lewis

I recently heard a story about the man who rises early in the morning, begins his work immediately, puts nothing off until tomorrow that can be completed today, and finishes the day successfully, feeling good about himself.

And there is the man who sleeps as late as possible, then, in an attempt to meet his various responsibilities must "trot" all day in an effort to "catch up," seldom if ever completing his tasks, and practically never feeling successful.

As I listened to this anecdote on the radio while driving to school one morning, the likeness of the "late riser" to some of my L. D. students immediately struck me. For one reason or another they didn't get off to "an early start," and are gradually getting farther and farther behind in their regular class work, experiencing failure after failure. Even with the extra help they receive, the gap widens and the "trot" must become a gallop if they are to "catch up" to their grade level.

In the past, some students placed in my L. D. resource room were also retained in their regular class for an additional year. Several of these students were able to successfully complete the assignments in the repeated grade and no longer needed the extra help. Once they were able to experience success, it was contagious, and success continued. But these are also those students whose parents do not want their child retained, even though the gap between his academic placement and what the child is capable of achieving at the time may be lessened. So, the child must "trot" on, and on, and on . . . . I'll keep trying to help him "catch up."

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Different Perceptions of Reality

Don Larson

Upon completing the week long seminar with Dr. O'Brien, I walked out to my motorcycle to find a parking ticket. I was shocked. I had bought the green permit and had parked in the proper area, so why the ticket?

In the remarks area was written, "NO PERMIT." Walking to the rear of the bike, I saw the plate with the permit was indeed missing. While riding home, Tom's voice kept ringing in my ears, "The way one person perceives a situation may be completely different from someone else."

My reality was that I had a permit to park there, while Badge No. 164 said I didn't. Neither of us was completely correct and the situation was quickly taken care of. Later, a thought occurred to me -- one should not observe things once, formulate a thought or an opinion, and use that idea in every other encounter with that person or object.

I should have checked for that permit which I just expected to be there. Changes happen around us continually and we should observe them; especially if it might mean an improper label on a student, or a one-shot evaluation of a student instead of constantly correcting our evaluations as the student develops or matures.

Learn, Develop, and Come Back for More

Anne Betscher

Kids must be led to learn both the programs and processes of their environments. I use the term program to refer to the type of knowledge that is "given." Programs are the facts and rules which any particular society expects one to know (understand, store in memory, and recall) by a certain age. For example, "all proper nouns are capitalized, the capital of Ohio is Columbus, and VII = 7" are conventions of a culture and are learned and used as a computer uses a program. That is, the need is recognized, the rule recalled, the variable plugged in, and the answer computed. If there is no error in the program the answer will be correct. Often the teaching of programs dominates the school day.

Kids must also be led to develop their thinking processes. I use the term process to refer to the organization of the series of steps required to determine a solution. Strategies used in solving problems are processes. Each step in a problem-solving process may require the use of a unique program or of a previously used program at a different depth.

The development of thinking processes most often occurs outside the classroom. For example, a houseperson uses a thinking process in deciding the dinner menu. "The spouse doesn't like a, b, and c. The kids won't eat f - o. The family ate x, y, and z for supper last night. There are no ingredients in the cabinet for q, r, and s. It needs to be ready in 45 minutes, etc." This particular strategy is known as the process of elimination. It is a simple process, available to most people. But just as programs range from simple to complex so processes range from this simple example to more complex strategies.

Just as kids must learn programs they must develop processes. The teacher's role, then, is to help kids make advancements toward their potentials in both areas. It is my belief that learning a new process is similar to learning a new program in that each child has a ceiling beyond which she can learn no more at a particular time. Furthermore, in both realms, advancement requires effort. More effort will be required of every person as he approaches his learning limit. Perhaps this is why so few of us ever near this potential.

But, if as I have assumed, the goal of elementary education is to increase the student's capability to solve life's problems, then yet another "subject" must be taught. Kids must be "inspired" to become independent problem solvers. They must have the desire as well as the ability to find and define new problems to challenge and to develop their mental capacities. Children must desire to cultivate more efficient processes while continually adding to and deepening their program banks. In school we can pressure kids into learning, but in life they must willingly pressure themselves.

So, kids must be led to learn both the programs and processes of their environments. But this learning should never stop. Therefore, kids must also be helped (or at least not hindered) to enjoy learning, to willingly seek new problems with which to expand and develop their minds.

All Mixed Up?

Don Larson

Recently, I was asked to take care of my three nephews and one niece while their parents were out. Paul (7), Mona (6), Justin (5), and Ray (3½) were easily amused with Kismet, Yahtzee, and Uno for the major portion of the day. Paul and I decided to play Chess, which I explained to him in detail before we played.

Mona and Justin got into the act and soon the three were playing primitive games of Chess which I observed and corrected when necessary. Ray sat and observed, finally asking to play.

To begin play one person takes a pawn of each color, shakes them inside his hands and then hides one inside each hand. He then presents his closed hands to the other who chooses one hand. The color of the pawn inside that hand is the color that person plays with. I told Ray to shake them up, which he did - sort of. The left hand had the black, the right the white as he raised his fists above his head and shook them somewhat akin to Rocky's dance at the top of the stairs.

He then held them out for me to choose and continued with the game. His concept of what was hidden being able to be mixed up even though they were never mixed and separated was interesting. Luckily his game was better than his mixing.

Who Has?

Marjorie McEnany

This activity encourages the students to mentally compute problems. The following sentences are written on individual pieces of tagboard and laminated. The teacher keeps a list of the problems for checking. Each child receives a sentence and reads:

I have 0. Who has this plus a dozen more?
I have 12. What comes after 12?
I have 13. Who has a dozen more?
I have 25. Who has 4 less?
I have 21. Who has 3 more?
I have 24. Who has this divided by 4?
I have 6. Who has 8 more than I?
I have 14. Who has two times this?
I have 28. Who has 5 less?
I have 23. Who has 4 less?
I have 19. Who has this plus 10 more?
I have 29. Who has 2 more?
I have 31. Who has this minus 27?
I have 4. Who has twice as many?
I have 8. Who has 6 fewer than I.
I have 2. Who has 9 times as many?
I have 18. Who has 17 more than I?
I have 35. Who has 30 less than I?
I have 5. Who has 5 more?
I have 10. Who has 3 less?
I have 7. Who has 10 more?
I have 17. Who has 3 more than I?
I have 20. Who has 20 more than I?
I have 40. Who has 10 more than I?
I have 50. Who has 8 less than I?
I have 42. Who has 42 fewer than I?

After the students had participated in this activity several times, they were asked to work in groups and write their own number facts for "Who Has".

The students enthusiastically began the work but not all groups completed the task. It would probably have been better to have divided the class and let some of the students work on another activity. However, all in all, it seemed to encourage the students to become more involved in organizing learning.

Thoughts

Don Larson

During one discussion, Mary and I were sharing ideas on number line images and how we perceive them in our minds. Mary stated that when she pictures the line in her mind, the (1, 2, 3. . .) section is larger and the spaces wider than the (201, 202, 203. . .) section.

After thinking about this, I asked a number of people to imagine different points along the number line in their head. In every case, the point of focus was larger/wider than the rest of the line (eg. 50, 51, 52. . . larger than 1, 2, 3. . . or 101, 102, 103. . .).

When asked to focus farther along the line, that point became larger. I thought for a while on why that would be. Then it occurred that it had to be that way because the point you look at will be the center of your line going in equal length to both sides. You mind automatically makes this section larger.

I finally found a "real world" example of this with the Parthenon. Along its side there are 17 columns (not counting the rear/front corner columns which compose the rear/front face and are larger than the rest). The center six columns are slightly smaller than the rest on the front and back. Along the side the inner 15 columns are narrower than the corners, and the base rises about four inches toward the center column. This makes the center columns thinner and shorter than the rest, yet when viewed from a distance it appears perfectly symmetrical.

Red, blue, brown and tan tints to the marble and tilting the columns inward also aid in this effect; however, the size of the columns has the greatest effect on the mind which makes the center as large as the ends.

Impact Maths

In the summer of 1979 Jan Stanfield and Jerzy Cwirko-Godycki joined Tom O'Brien in sparking the Teachers' Center Project's 8th annual summer course. The seeds they scattered for doing math (especially with dice and dominoes) are still growing here.

Recently, we received copies of Impact Maths (Pupil Books 1 and 2), Jan and Jerzy's new books, intended for remedial work with kids.

Let us quote from the introduction:

> The Impact series is designed to give children a reasonable standard of fluency in the use of numbers and space. By this we mean a competency in everyday situations and a feeling for simple mathematical operations and structures.
>
> The teaching strategy adopted by the authors does not rely on the relentless repetition of practice sums. Key concepts and procedures are approached again and again using a variety of visual presentations and activities.
>
> The series uses the very minimum of words and the illustrations are not age-related.

It is with pleasure that we (with permission of Evans Brothers Limited, the publishers) reprint a sampling of pages from these books.

They may be ordered from Evans Brothers Limited, Montague House, Russell Square, London WC1B 5BX, England, at a cost of $2.30 each plus tax and shipping.

Some of the pages were reprinted singly and some were reprinted in pairs. Original page numbers were retained for purposes of clarity.

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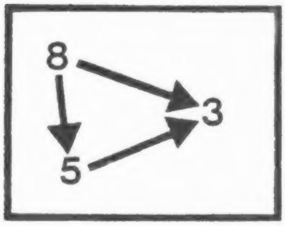
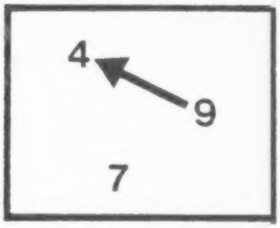


b



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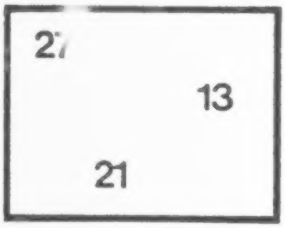

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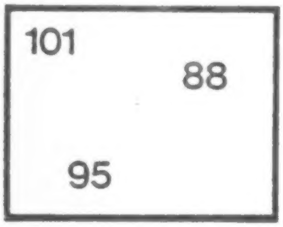

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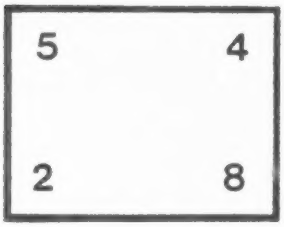

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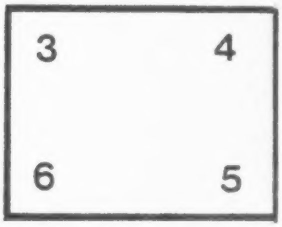
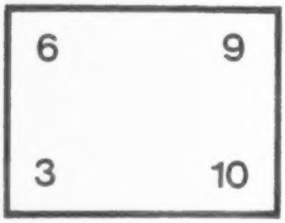


g



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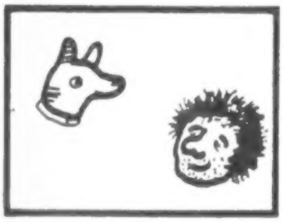
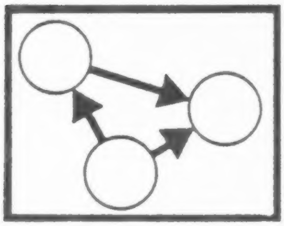


Copy and write in the missing numbers.

i



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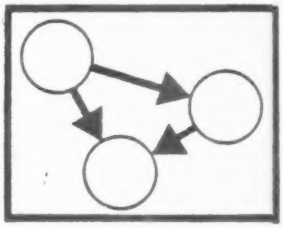

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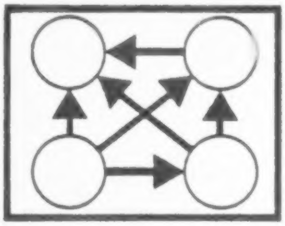

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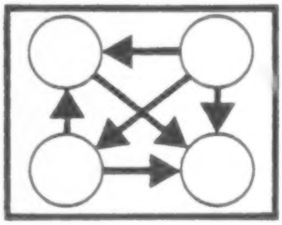


4 Copy and write in the missing signs.

a $2 + 4$ ⟨=⟩ $2 + 4$ b $6 - 2$ ◇ $6 \div 2$ c $8 + 1$ ◇ 8×1

d $5 + 0$ ◇ 5×0 e $8 - 2$ ◇ $8 \div 2$ f $2 + 2$ ◇ 2×2

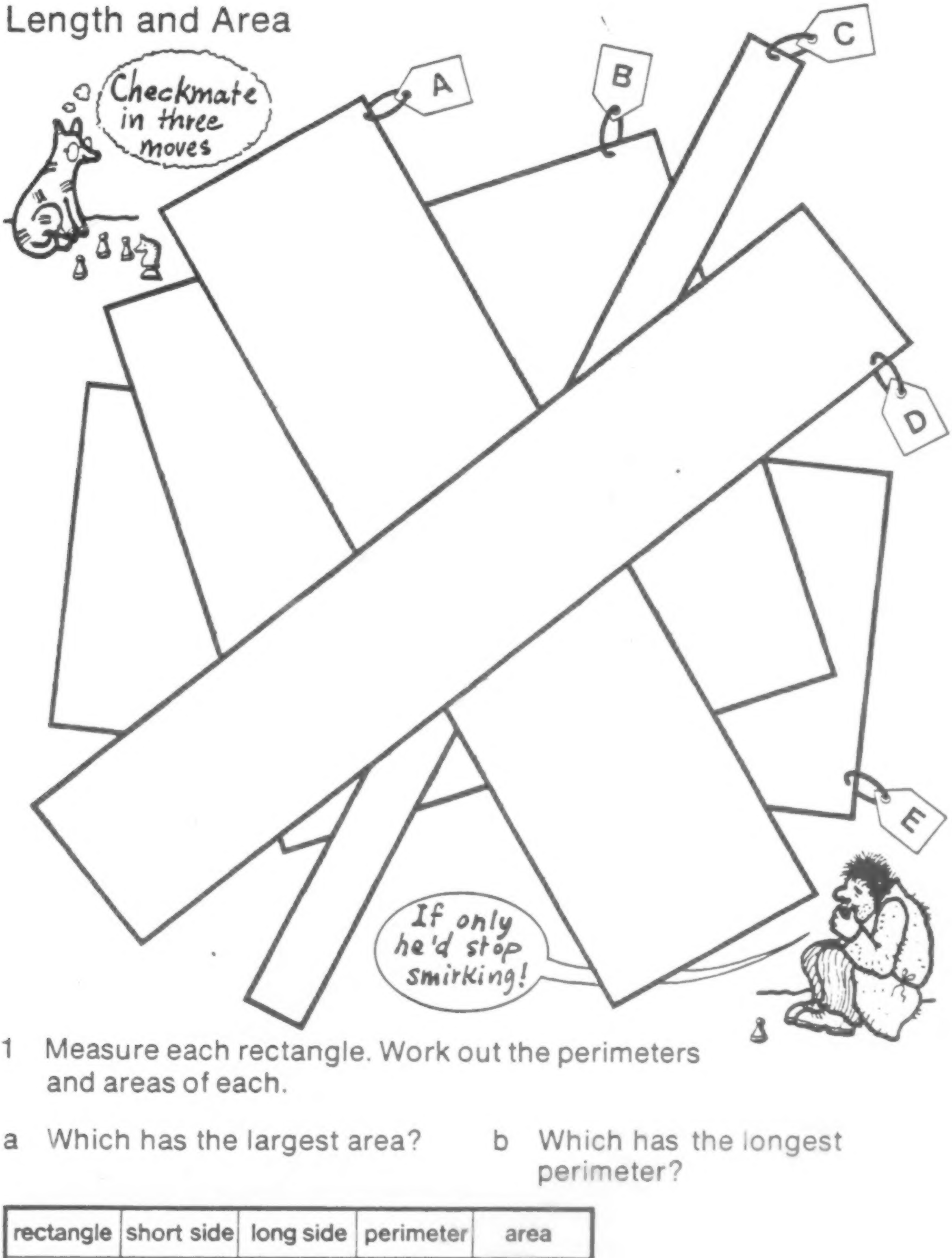
g 6×2 ◇ $6 \div 2$ h 3×0 ◇ 9×0 i 8×1 ◇ $8 \div 1$

5 Copy and write in the missing numbers.

a $5 + 3 < \boxed{}$ b $4 + \boxed{} = 10 - 1$ c $8 + 2 < 5 + \boxed{}$

d $7 + \boxed{} > 3 + 9$ e $12 - 3 > 5 + \boxed{}$ f $\boxed{} + 4 = 9 - 3$

Length and Area


Checkmate in three moves
A
B
C
D
E
If only he'd stop smirking!

1 Measure each rectangle. Work out the perimeters and areas of each.

a Which has the largest area?

b Which has the longest perimeter?

rectangle	short side	long side	perimeter	area
A	4cm	16cm	40cm	64cm^2

2 Draw a proper chessboard. Divide it into:

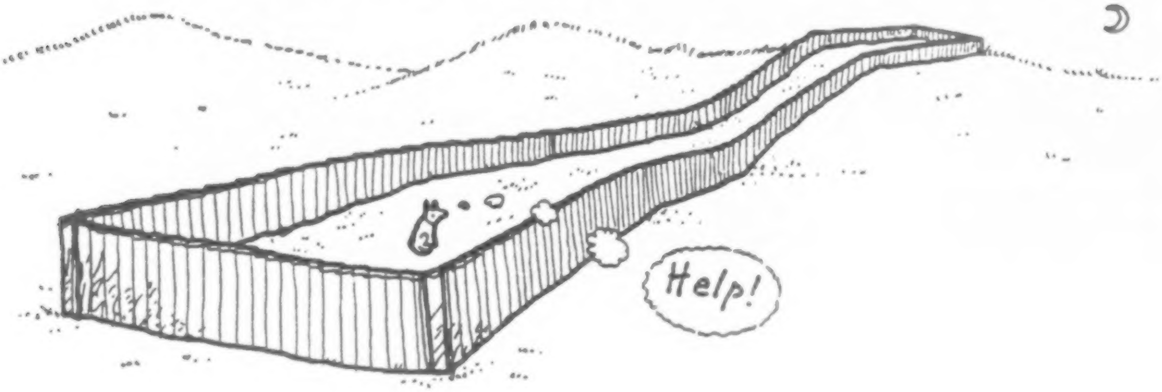
a 3 rectangles b 4 rectangles

Find the area of each rectangle.

3 Using twenty 3-metre fences make:

a the largest corral b the smallest corral

Draw each, making 1cm stand for 3 metres.



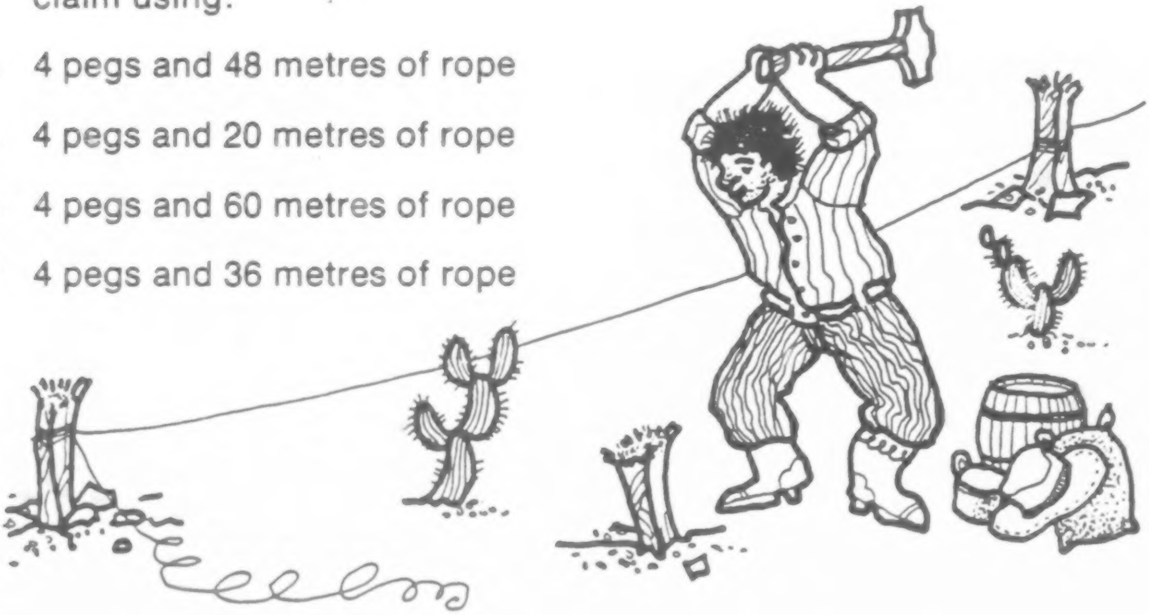
4 In the Goldfield Rush stake out the biggest claim using:

a 4 pegs and 48 metres of rope

b 4 pegs and 20 metres of rope

c 4 pegs and 60 metres of rope

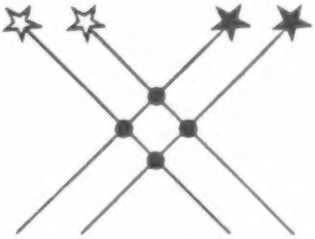
d 4 pegs and 36 metres of rope



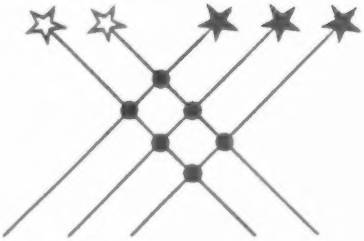
Crossings

1 How many crossings?

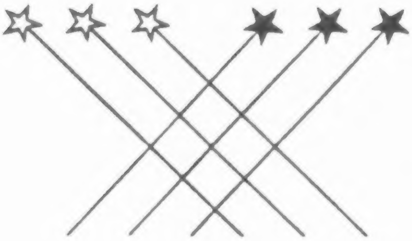
a



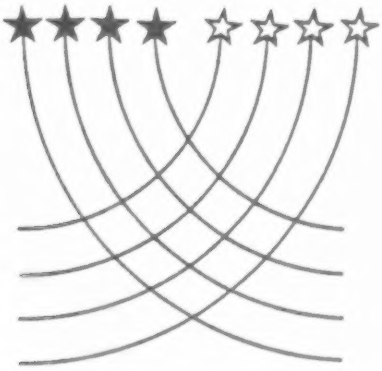
b



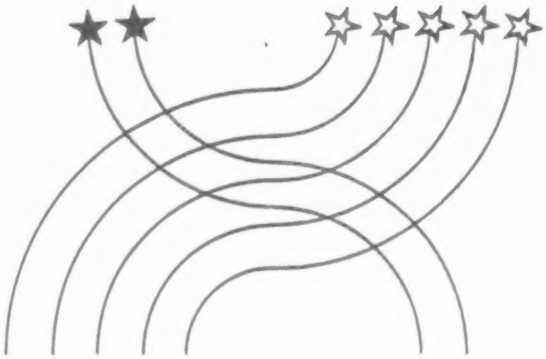
c



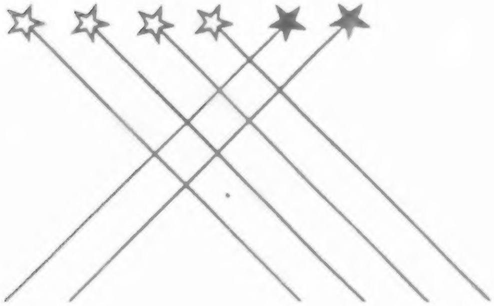
d



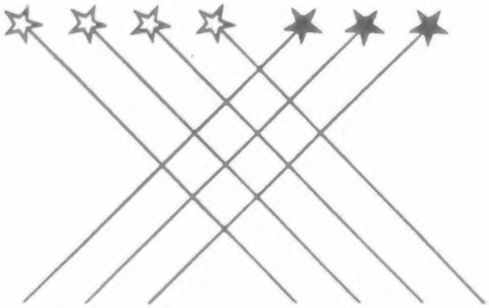
e



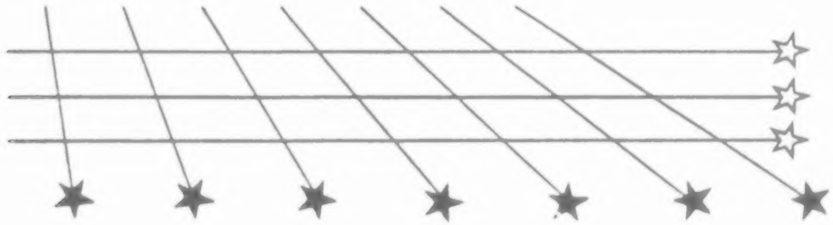
f



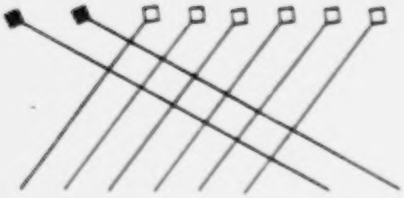
g



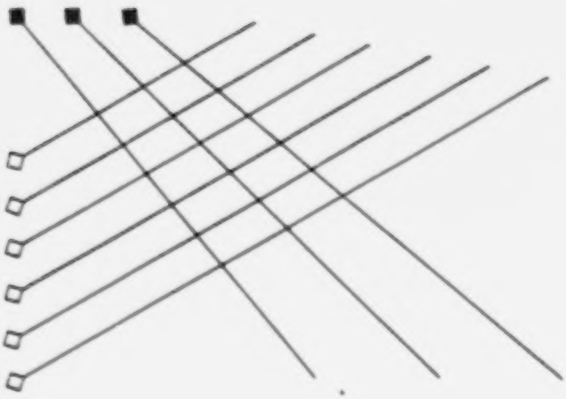
h



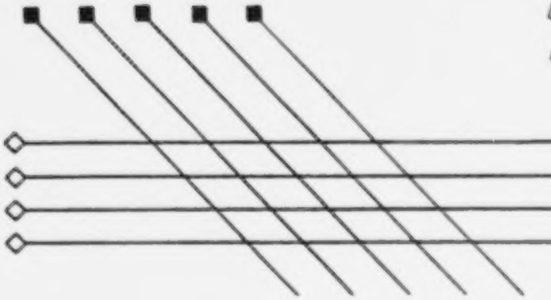
i



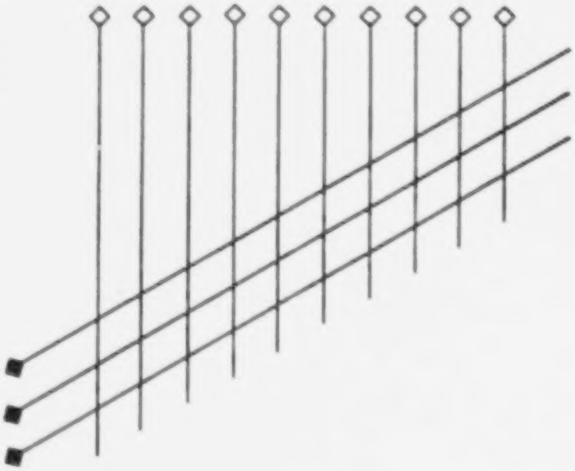
j



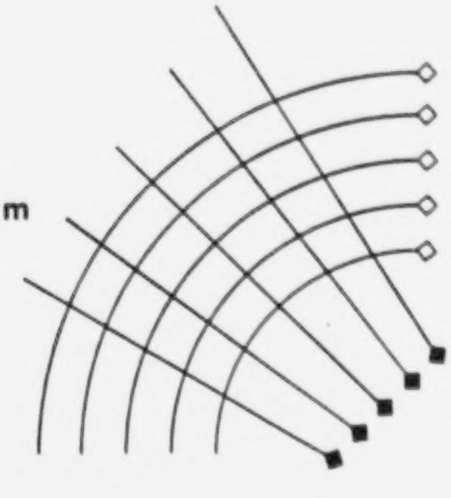
k



l



m



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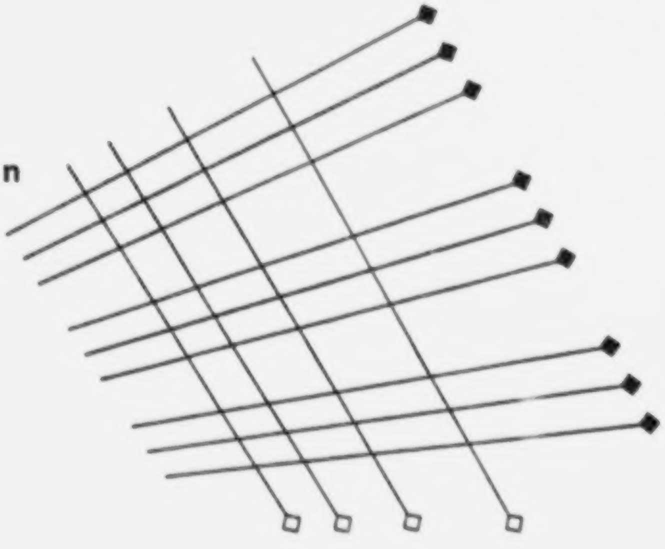


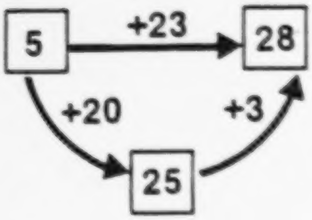
Make this table for answers:

	☆◇	★◆	crossings
a	2	2	4
b	2	3	

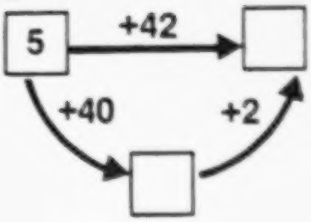
Adding in Stages

1

a


5
+23
28
+20
+3
25

b



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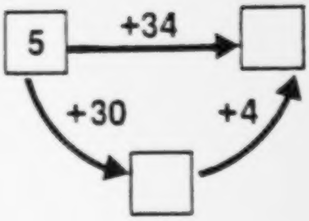

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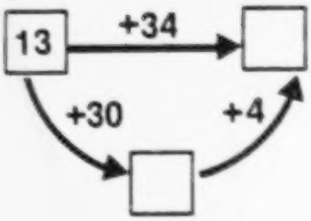

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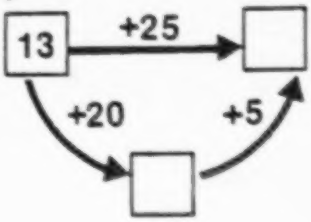

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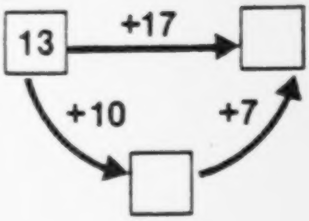
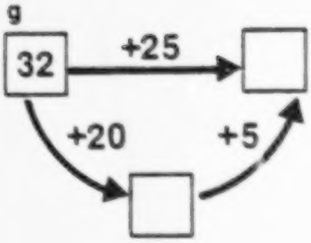


g



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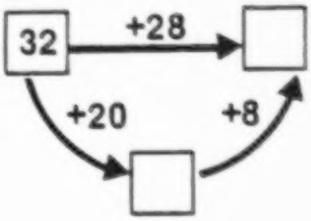

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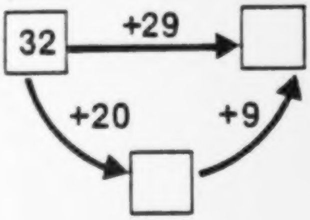

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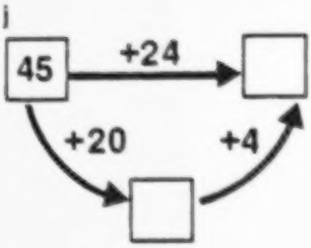

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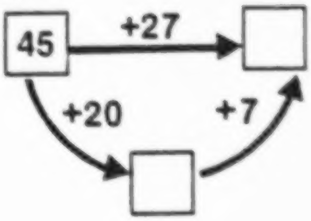

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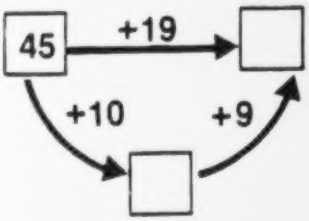

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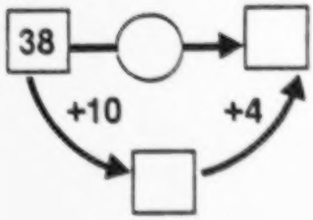

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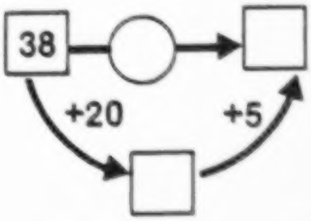

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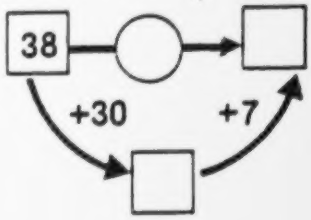
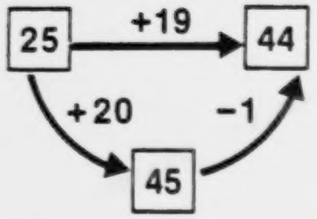
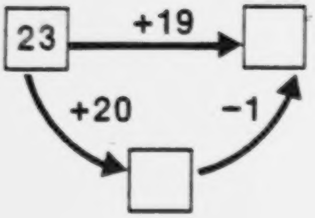


2 a


25
+19
44
+20
−1
45

b



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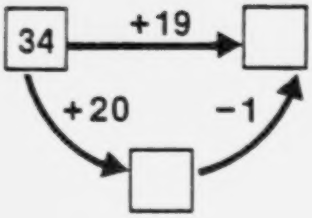

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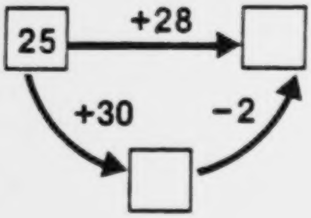

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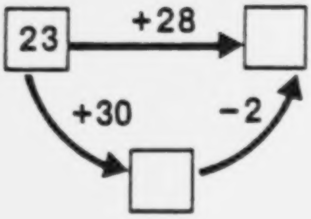

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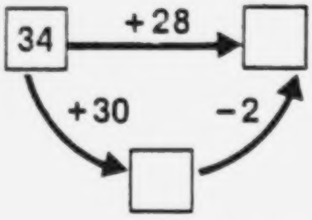

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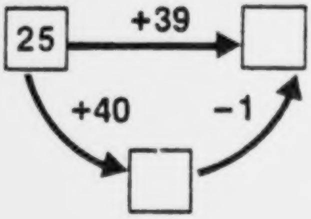

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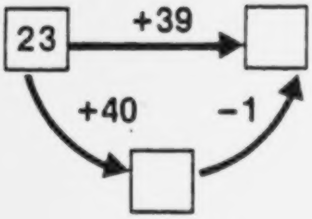

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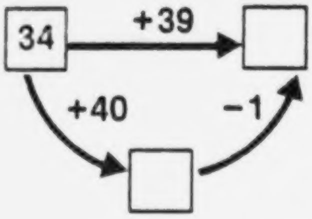

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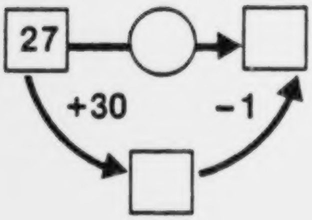

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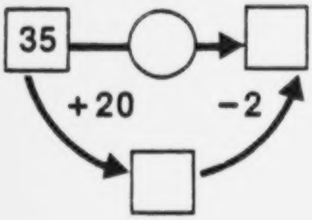

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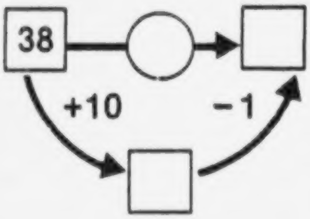

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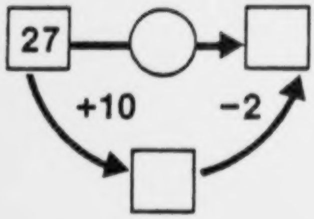

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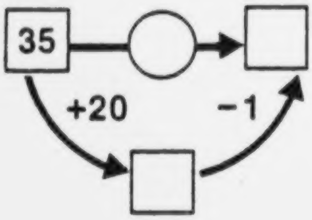

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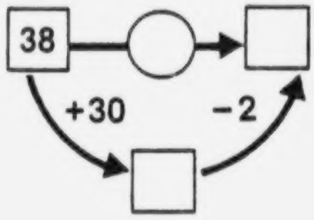
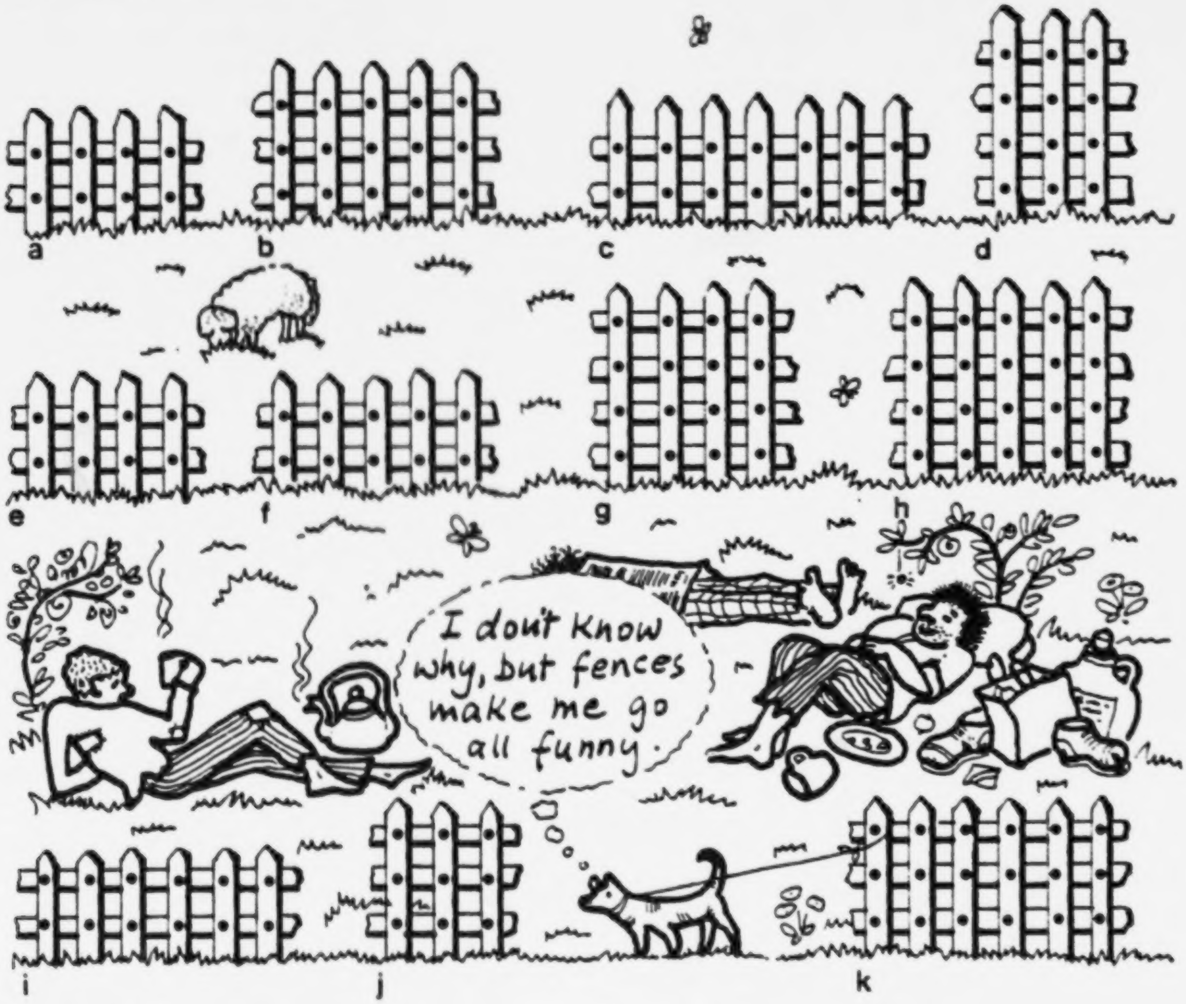


Multiplying Fences


a
b
c
d
e
f
g
h
I don't know why, but fences make me go all funny.
i
j
k

1 Complete this table:

	uprights	cross pieces	nails used
a	4	2	8
b	5		

2

a

×	2	4
3	6	
5		

b

×	3	6
3		
6		

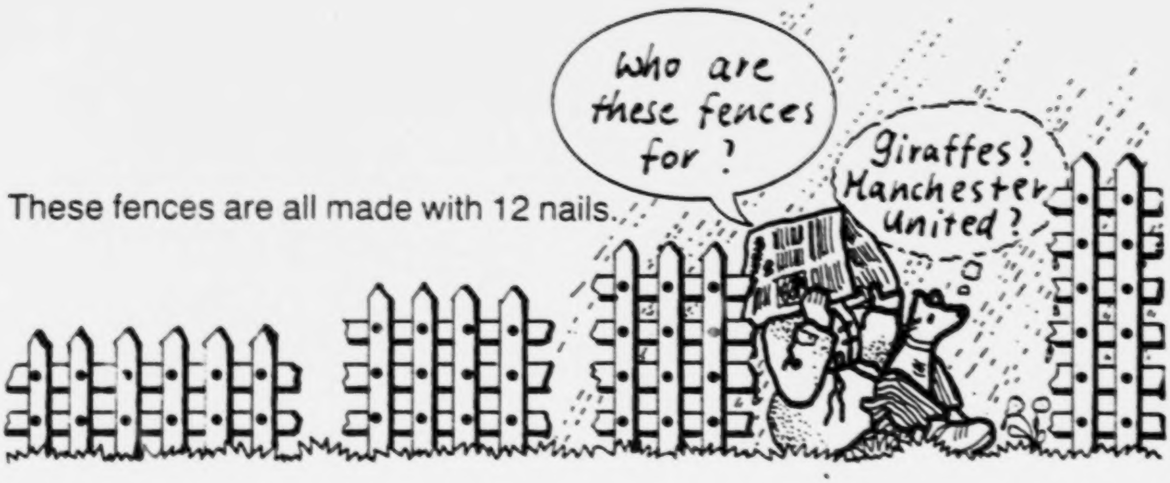
c

×	2	5
5		
2		

d

×	6	5
4		
7		

These fences are all made with 12 nails.


Who are these fences for ?
Giraffes? Manchester United?

3 Draw as many fences as you can, using

a	15 nails	b	18 nails	c	24 nails	d	16 nails
e	30 nails	f	25 nails	g	20 nails	h	17 nails

4 Draw fences using

a	4 nails	b	9 nails	c	25 nails	d	49 nails

What do you notice?

5 Try drawing fences using these numbers of nails:
Watch out! They're not all possible!

a	6 nails	b	5 nails	c	10 nails	d	13 nails
e	19 nails	f	21 nails	g	28 nails	h	29 nails

Dice

STOP going on about how many spots you are sitting on.
Pitiful! Ask him to think and he turns nasty

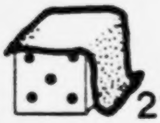
1 How many spots on

a one die **b** two dice **c** three dice

d four dice **e** five dice

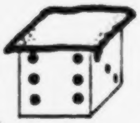
2 How many spots *cannot* be seen by you in each picture?

Example:

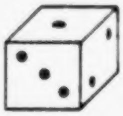


21−5=16

a



b



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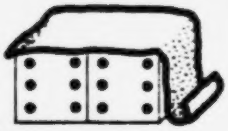
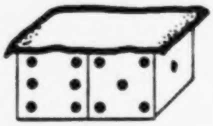
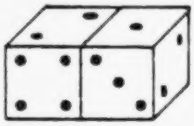


d



e



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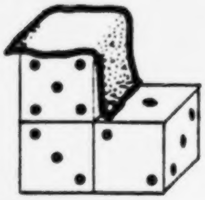

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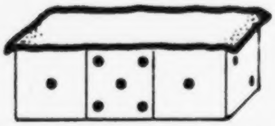

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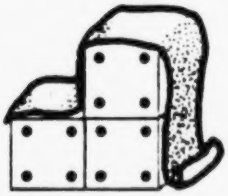

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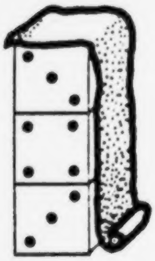

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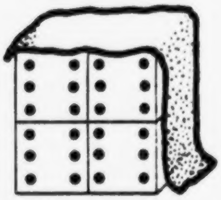

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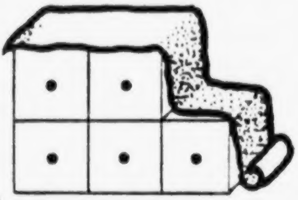
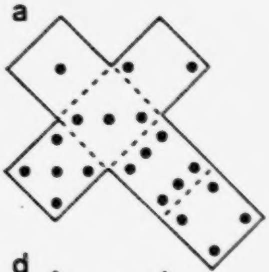


l

3 Opposite faces of a normal die add up to 7.
Which nets, when cut out and folded, will make normal dice?

a



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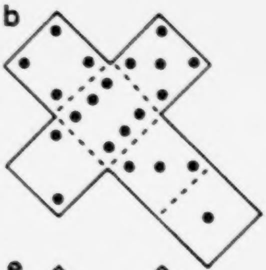

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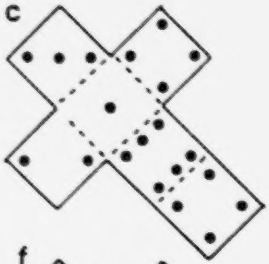

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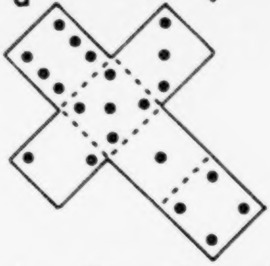

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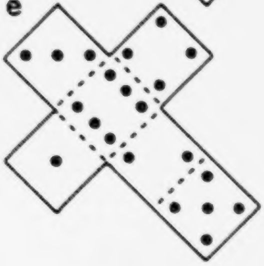

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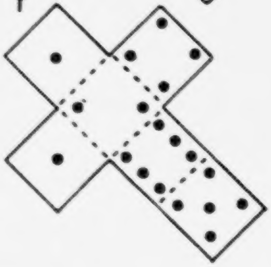
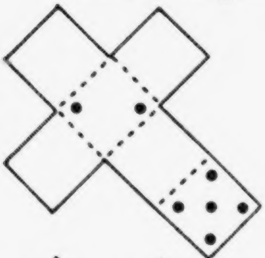
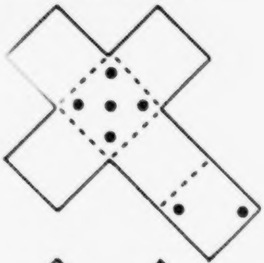
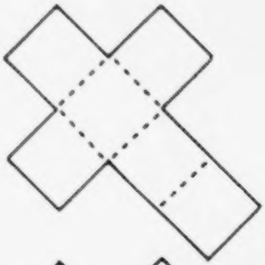
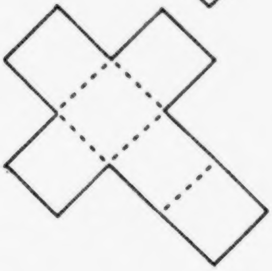


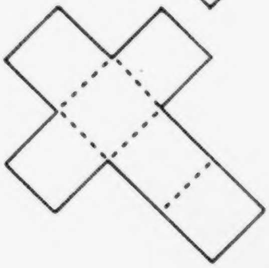
4 Copy these 6 nets.
On them draw spots to make dice.
Make sure that opposite faces add up to 7.
Each diagram must look different!

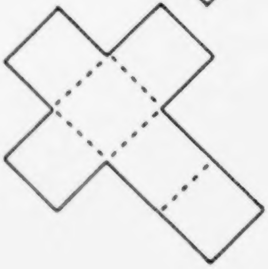




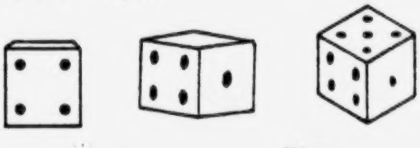








5 How many spots can you see by glancing at a die?
Write out all the possibilities.



Containers

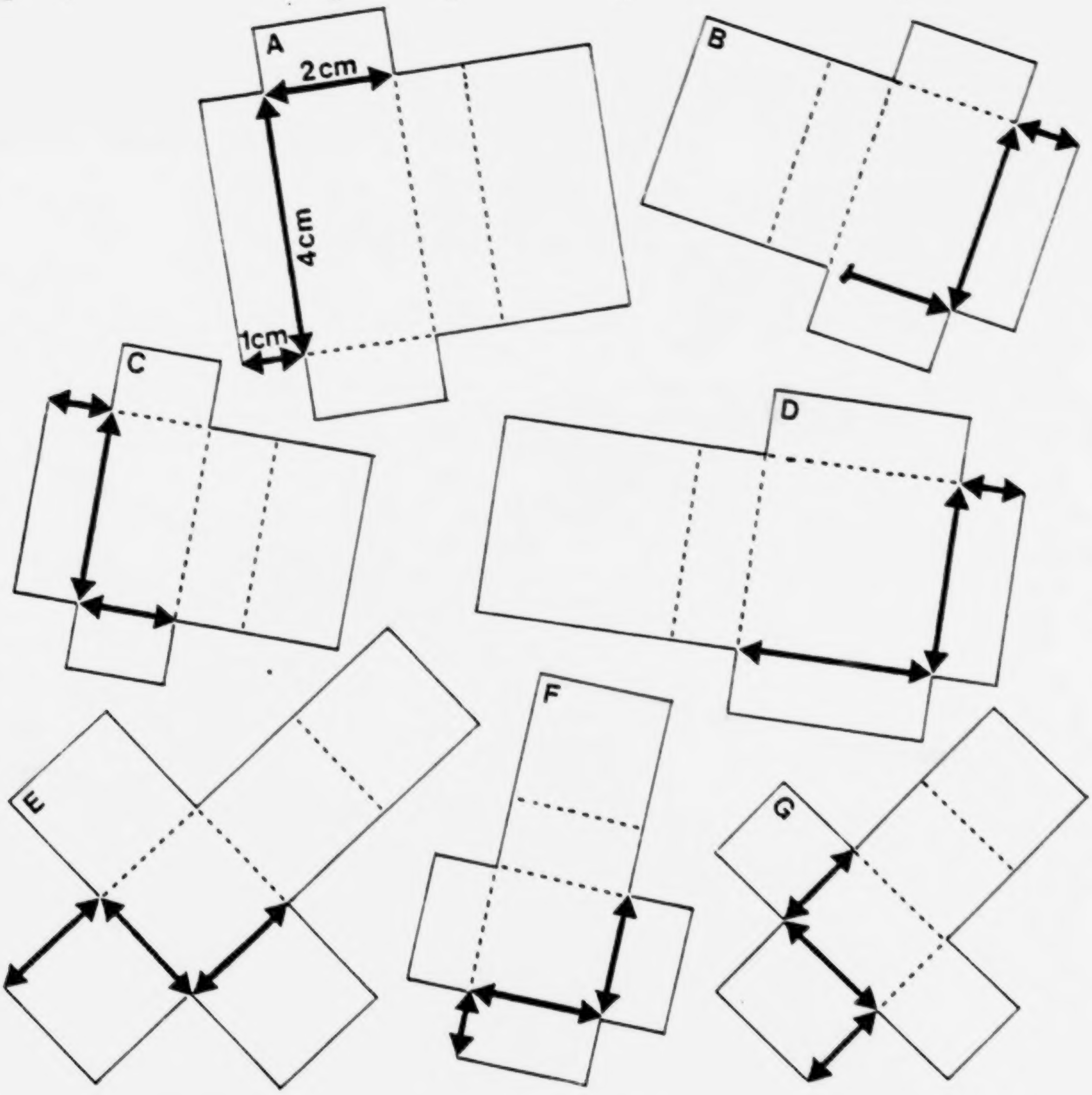
Which net, when folded, will wrap snugly around which object on the opposite page?
First compare measurements.

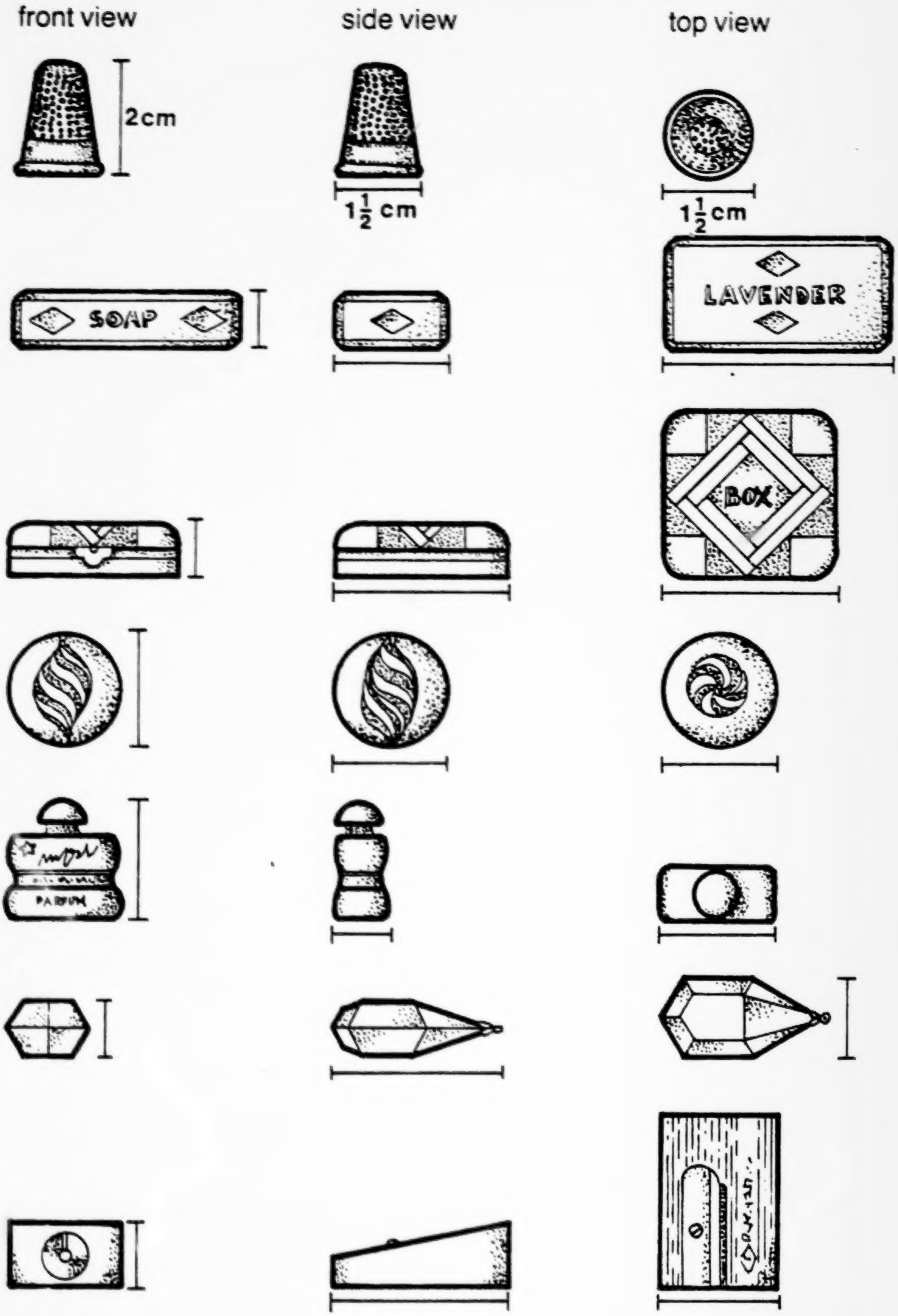
containers

A	2 cm, 4 cm, 1 cm
B	
C	

objects

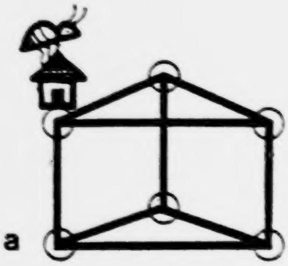
thimble	2 cm, $1\frac{1}{2}$ cm, $1\frac{1}{2}$ cm
soap	



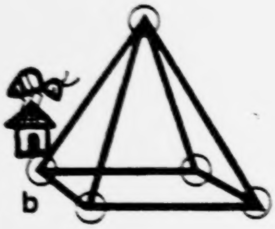

front view
side view
top view
2cm
1½ cm
1½ cm
SOAP
LAVENDER
BOX
PARFUM

The Wandering Bug

a



b



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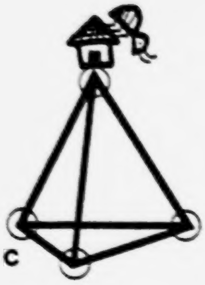

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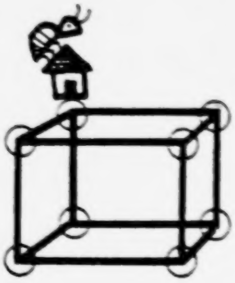
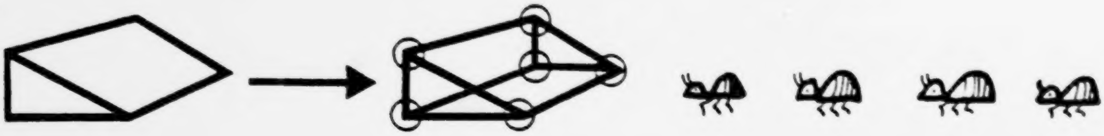


1 The bug goes for the longest possible walk and returns home.
The bug can crawl along any edge once only.
But it can visit a corner more than once.
What is the greatest number of edges he can walk along?

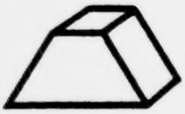
shape	edges walked	edges missed	total edges
a	6		
b			

2 How many sticks (edges) and corners (vertices) are needed to make these:

a



b



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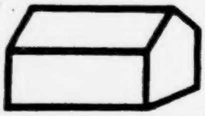

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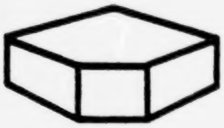

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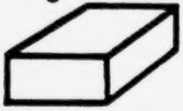
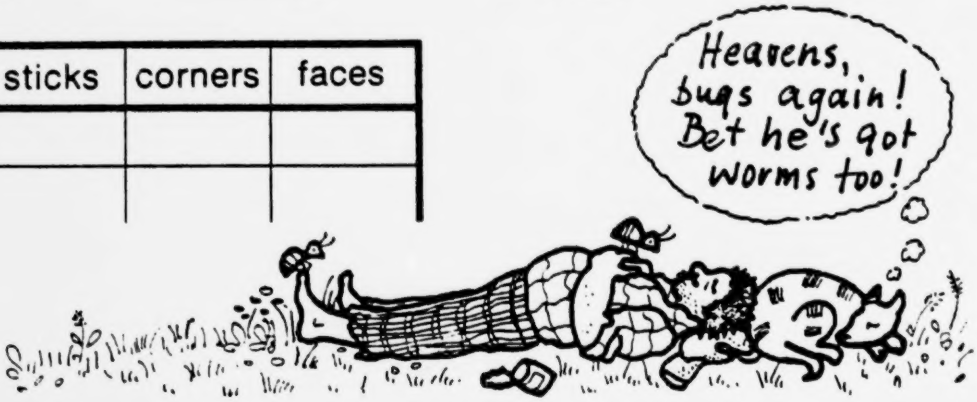


shape	sticks	corners	faces
a			
b			


Heavens, bugs again! Bet he's got worms too!

Changing Additions

Copy and finish.

1a
$$\begin{array}{r} 8 \\ +7 \\ \hline 15 \end{array} \rightarrow \begin{array}{r} 9 \\ 6 \\ \hline 15 \end{array}$$

b
$$\begin{array}{r} 18 \\ 6 \\ \hline 24 \end{array} \rightarrow \begin{array}{r} 19 \\ \boxed{} \\ \hline 24 \end{array}$$

c
$$\begin{array}{r} 24 \\ 13 \\ \hline 37 \end{array} \rightarrow \begin{array}{r} 25 \\ \boxed{} \\ \hline 37 \end{array}$$

d
$$\begin{array}{r} 25 \\ 15 \\ \hline 40 \end{array} \rightarrow \begin{array}{r} 24 \\ \boxed{} \\ \hline 40 \end{array}$$

e
$$\begin{array}{r} 32 \\ 13 \\ \hline \underline{} \end{array} \rightarrow \begin{array}{r} 31 \\ \boxed{} \\ \hline \underline{} \end{array}$$

f
$$\begin{array}{r} 28 \\ 22 \\ \hline \underline{} \end{array} \rightarrow \begin{array}{r} 27 \\ \boxed{} \\ \hline \underline{} \end{array}$$

g
$$\begin{array}{r} 43 \\ 16 \\ \hline \underline{} \end{array} \rightarrow \begin{array}{r} 40 \\ \boxed{} \\ \hline \underline{} \end{array}$$

h
$$\begin{array}{r} 27 \\ 11 \\ \hline \underline{} \end{array} \rightarrow \begin{array}{r} 23 \\ \boxed{} \\ \hline \underline{} \end{array}$$

2a
$$\begin{array}{rcr} 5 & \xrightarrow{+2} & 7 \\ \underline{+3} & \xrightarrow{-2} & \underline{1} \\ \underline{8} & & \underline{} \end{array}$$

b
$$\begin{array}{rcr} 14 & \xrightarrow{+3} & 17 \\ \underline{16} & \xrightarrow{-3} & \underline{13} \\ \underline{} & & \underline{} \end{array}$$

c
$$\begin{array}{rcr} 18 & \xrightarrow{+4} & 22 \\ \underline{13} & \xrightarrow{-4} & \underline{9} \\ \underline{} & & \underline{} \end{array}$$

d
$$\begin{array}{rcr} 25 & \xrightarrow{+1} & \\ \underline{17} & \xrightarrow{-1} & \underline{} \\ \underline{} & & \underline{} \end{array}$$

e
$$\begin{array}{rcr} 35 & \xrightarrow{+3} & \\ \underline{24} & \xrightarrow{-3} & \underline{} \\ \underline{} & & \underline{} \end{array}$$

f
$$\begin{array}{rcr} 42 & \xrightarrow{+4} & \\ \underline{18} & \xrightarrow{-4} & \underline{} \\ \underline{} & & \underline{} \end{array}$$

g
$$\begin{array}{rcr} 40 & \xrightarrow{+10} & \\ \underline{20} & \xrightarrow{-10} & \underline{} \\ \underline{} & & \underline{} \end{array}$$

h
$$\begin{array}{rcr} 50 & \xrightarrow{+20} & \\ \underline{80} & \xrightarrow{-20} & \underline{} \\ \underline{} & & \underline{} \end{array}$$

i
$$\begin{array}{rcr} 30 & \xrightarrow{+30} & \\ \underline{70} & \xrightarrow{-30} & \underline{} \\ \underline{} & & \underline{} \end{array}$$

Visual Difference 1

1 How much is shaded in each block?

2 What is the difference between the shaded and unshaded areas?

1a

30 − 14 = 16

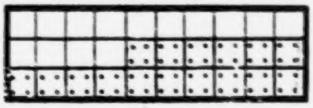
ans = 16 shaded

2a

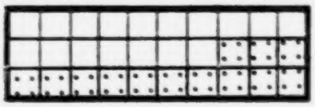
16 − 14 = 2

ans = 2 more shaded

a



b



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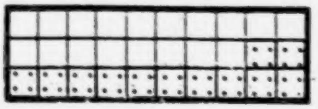

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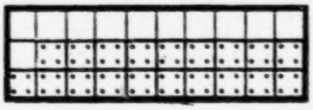

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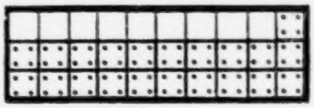

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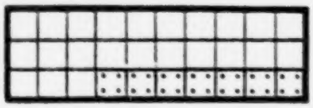

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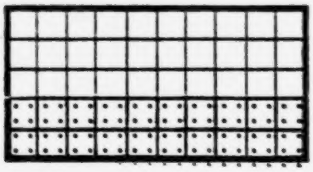

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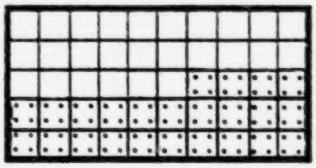

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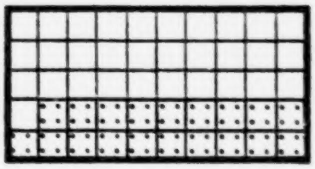

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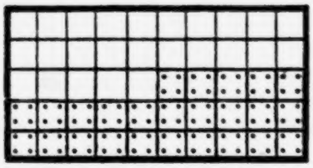

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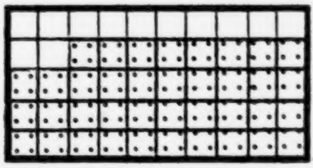

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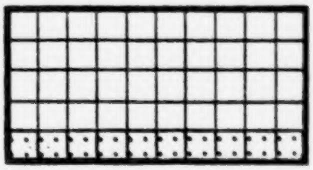

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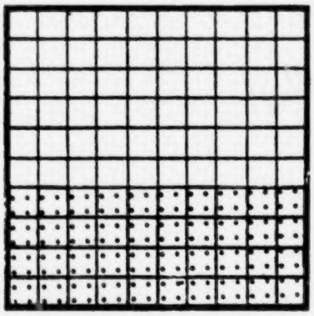

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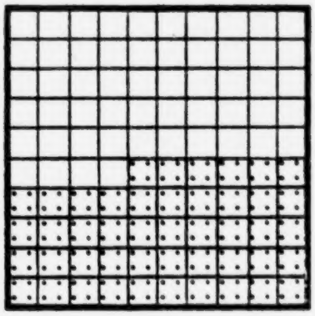

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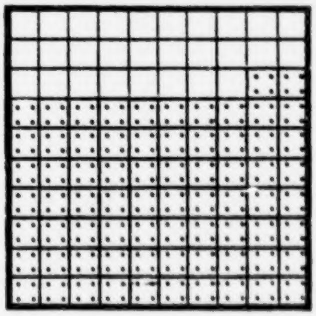

Scatterers

Anne Betscher
Mulberry Grove Elementary School
Mulberry Grove, Illinois

Bill Brainerd
Hazelwood Central High School
Florissant, Missouri

Shirley Casey
Southern Illinois University
Edwardsville, Illinois

Deborah Churchman
Belleville News-Democrat
Belleville, Illinois

Dennis Craft
Jefferson Elementary School
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52 East 41st Place, Apt. 8
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Annemarie Garcia
Whiteside School
Belleville, Illinois

Edward A. Graves
Central School
O'Fallon, Illinois

Syvella Gregory
Lewis and Clark School
Alton, Illinois

Fred M. Hechinger
New York Times News Service
New York, New York

Sally L. Herzberger
Dorris School
Collinsville, Illinois

Donald A. Larson
Southern Illinois University
Edwardsville, Illinois

Martha J. Lewis
Kreitnew School
Collinsville, Illinois

Pamela J. Masulla
Pocahontas Center
Pocahontas, Illinois

Linda L. McDonnell
Parkview Elementary School
Granite City, Illinois

Marjorie McEnany
Central School
Roxana, Illinois

Helen L. Miller
Logan School
Granite City, Illinois

Tim Morton
Logan School
Granite City, Illinois

Thomas C. O'Brien
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Edwardsville, Illinois

Arlene Plog
Pocahontas Elementary School
Pocahontas, Illinois

Marie Reeves
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Exeter
Devon
England

Lewis Thomas
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Cancer Center
New York, New York

Daffodil

Beautiful, Bright, Yellow,
Lovely

Bending, Flowering, Sprouting
Drooping

Wants people to love her.

Daffodil, the lovely, yellow
flower

Donna
Harwerth

SEEDBED

Number 9

July, 1981

Teachers' Center Project
Southern Illinois University
at Edwardsville

INTRODUCTION TO SEEDBED

It is with great pleasure that we bring you SEEDBED 9. Again we think we've come upon some issues that are thought-provoking. But most of them aren't just for reading. We encourage you to engage the problems presented. Build on them, extend them or (as Bob Jeffery would say) "bend them" to meet your own needs. It is not by accident that our little journal is called SEEDBED--we hope the issues you encounter here will grow and develop. We'd be interested to hear from those who've used some of the ideas presented here and in earlier issues--let us know which of them have worked for you and your students and which have not.

This issue of SEEDBED may seem a bit different to you. If so, it's because it was prepared while Tom O'Brien was on sabbatical leave. He enjoyed a most productive trip to England, France, Germany, Switzerland, Italy and Hungary. He's back now and "on fire" with new issues to be researched and new ideas fresh from germination. Stay alert for without doubt, the evidence of his European "graftings" will begin to show themselves.

Because of Tom's absence, the River Bluffs Teachers' Center and the East St. Louis Teachers' Center were inactive (at least officially) during Spring Quarter, 1981. We had a very active group in Belleville and from them comes what we hope will become a regular feature in upcoming SEEDBEDs--"Cuttings". Teachers kept a sort of diary on their weekly work. Some of their observations and comments were too good to lie buried in notebooks and files. So we took "cuttings" from them and have prepared them for sharing. We hope some of them take root and grow!

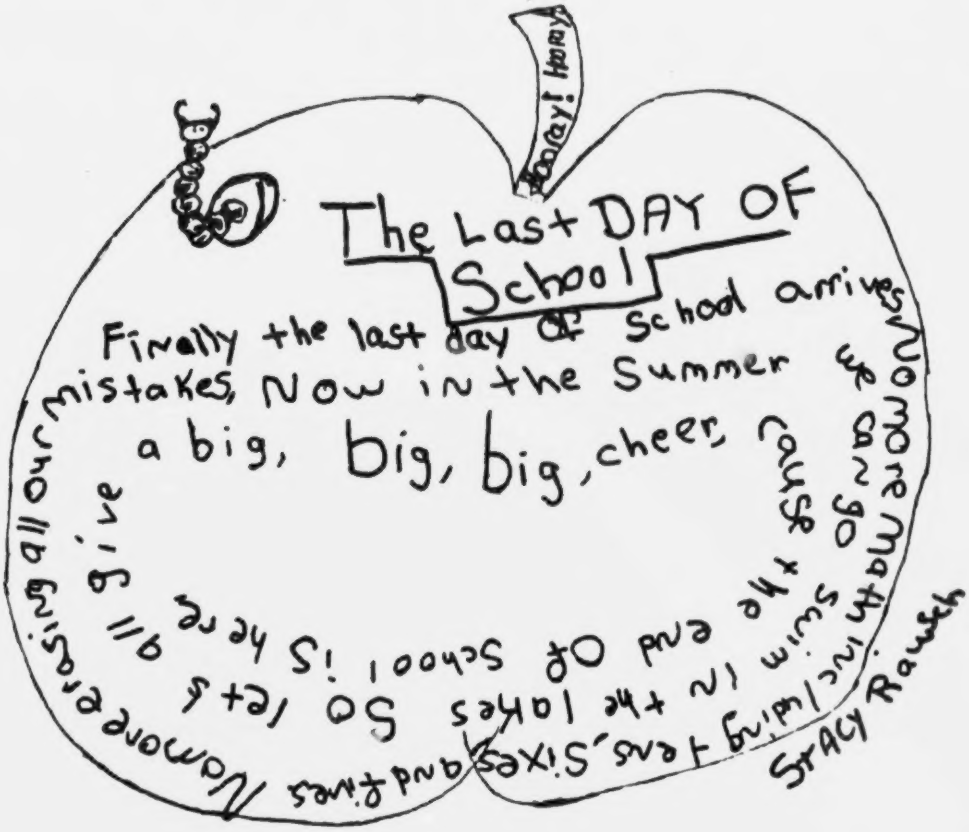
Our next big project will be our tenth annual summer course, which will be held August 16-22. This year we're most pleased to have Dick Tahta (University of Exeter) with us. Some of us have had the pleasure of meeting and briefly working with Dick at ATM Spring Conferences in England. We're delighted with the results of his work with Leapfrogs--a most imaginative and able mathematics education group in England, particularly the TV series called "Leapfrogs" on ATV. If you hurry, you still might be able to join us for Dick's visit. It wouldn't surprise me if SEEDBED 10 doesn't start there--for as Tom says, "Knowledge is not a spectator sport."

Shirley A. Casey
Shirley A. Casey

15 July, 1981
Edwardsville, Illinois

ABOUT THE COVER

On May 13, 1981, Professor Donald Darnell (SIUE's Spinner the Clown) worked with teachers at the Belleville Area Teachers' Center on "Creative Language Activities". It was a very productive session and several of the teachers did some of the activities with their students. One of these teachers, Linda Cadell, who teaches fifth grade at St. Agatha's School, New Athens, Illinois, has shared some of the children's illustrated poems. One of them appears on the cover and several others appear throughout SEEDBED 9. We hope you find them as delightful as we did.


Hooray! Hooray!

The Last DAY OF School

Finally the last day of School arrives
No more math including tens' sixes and fives
No more erasing all our mistakes,
Now in the Summer we can go swim in the lakes
cause the end of School is here
So lets all give a big, big, big, cheer,

STACY Rausch

THE SEEDS

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Jim Beattie

Creationism, Politics and Public Schools 3
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SO WHAT'S NEW?

Jim Beattie

Consider the following passage taken from the introduction to a reading text book:

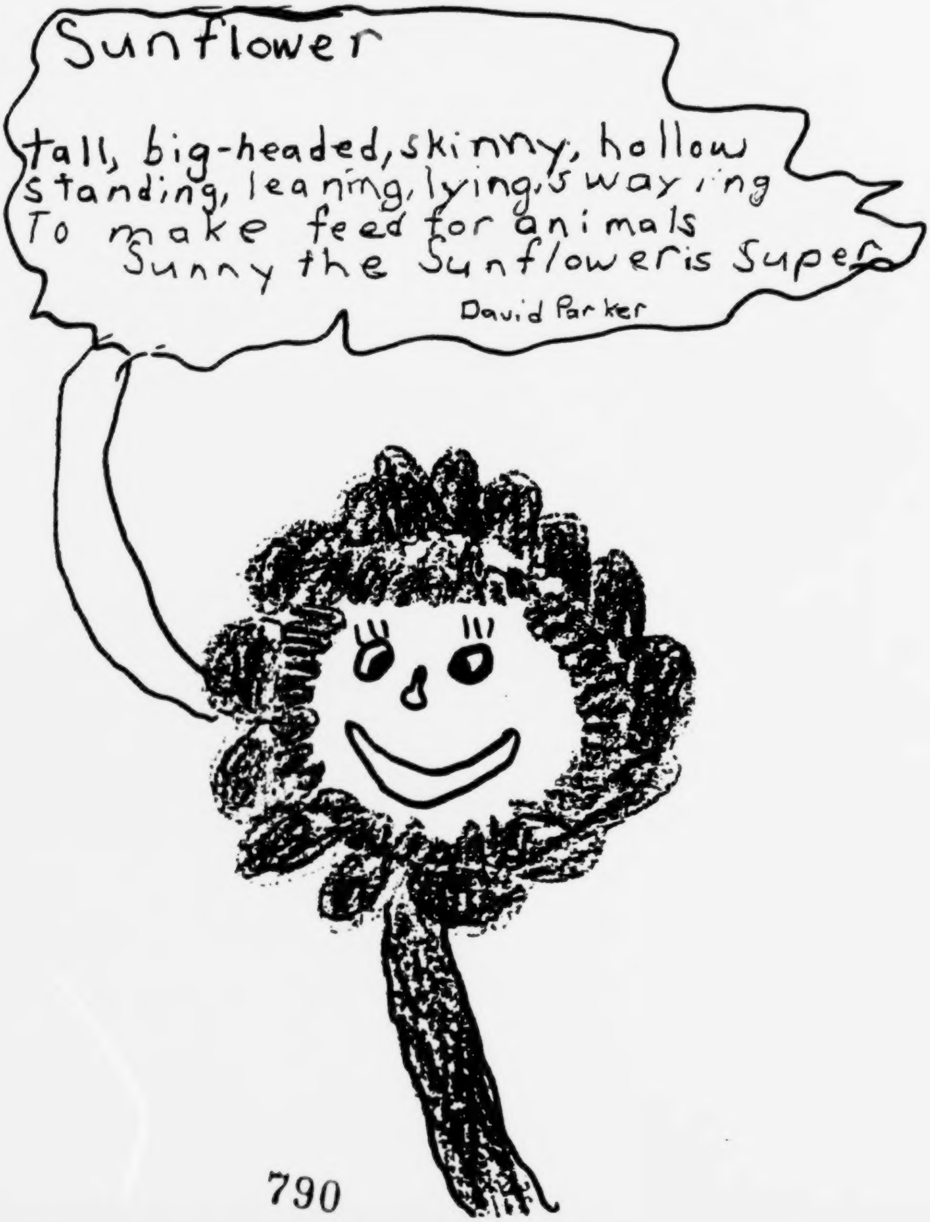
> This little book is offered to the public, in the hope that it may prove a valuable auxiliary to those engaged in the instruction of children.
>
> Great pains have been taken to select Lessons in which the language is simple, and the subjects interesting and NATURAL to childhood; as we have learned, from actual experience, that a child's progress is more rapid when the subjects are agreeable, and he can understand the terms in which they are conveyed.
>
> The Lessons are short, and many of them composed of words of one and two syllables. Much care has been taken to render them as progressive as possible, so that the child may not meet with expressions which are strange to his ear, and none that are above his comprehension.
>
> The Spelling Lessons are composed of words derived from the Reading Lessons. Some of the words are repeated in the spelling list of the different Lessons, and the more difficult ones, as often as they can be found. This is particularly necessary in a work of this juvenile character, where the Spelling Lesson is taken from the Reading Lesson.

The preceeding passage was taken from the introduction to McGuffey's *Eclectic First Reader*, copyright 1853. What we find in this passage are methods which we would call "progressive" in today's education. However, these ideas and methods have been available to us for at least one hundred thirty years.

Alistair McIntosh's article, "When Will They Ever Learn?" in *Mathematics Teaching*, March, 1979, reveals similar information. McIntosh wonders "why the lessons of sixty years ago, consistently advocated and upheld since then, have not yet extensively been put into practice. The aims are almost universally agreed in principle: their translation into accepted and practical terms for the majority of primary teachers has not yet come about."

To respond to this dilemma, I would like to quote William Van Til, professor of education at Indiana State University. When asked the question, "Why don't contemporary teachers know of major (educational) historical developments?" Van Til responded with what could be a partial solution. "Every generation has to find its own way. It has to learn and relearn. One of the things that happens as a person grows older, is that he looks back on experiences that he has had and other people have had. He often says, 'Why can't people know this? Why can't people profit from the past?' But probably the answer is that he himself didn't profit very much from the past. Every generation seems to have to relearn, to learn to find its own way."

Obviously all the answers to our educational problems cannot be solved through reviewing the past. However, more attention should be paid to the past. Educational methods that have proven successful generation after generation should be expanded and, when appropriate, incorporated into present educational programs.


Sunflower
tall, big-headed, skinny, hollow
standing, leaning, lying, swaying
To make feed for animals
Sunny the Sunflower is Super
David Parker

CREATIONISM, POLITICS AND PUBLIC SCHOOLS

Fred M. Hechinger

Last week's widely publicized case before a California judge in Sacramento began with a demand that pupils in California's public schools be informed by their science teachers that evolution is not the only theory that explains the creation of humankind. The trial concluded with a ruling by Judge Irving Perluss that existing state education policies did not violate the religious rights of people who object to the teaching of evolution.

But to placate the plaintiff, the judge directed the education authorities to circulate a policy statement to schools and textbook publishers that Darwin's theory of evolution should not be treated as a dogma of the "ultimate cause of origins."

The issue before the court seemed to be Act Two of the Scopes Trial of 1925, in which a biology teacher was found guilty of violating the Tennessee law against the teaching of evolution. Kelly Segraves, a California parent, brought suit to argue that his children were denied their right to be taught the biblical story of creation as another "model" of the way man arrived on this planet. To avoid any collision with the constitutional prohibition of teaching religion in public schools, the challengers insisted that they were advocating not religion, but a rival scientific version--scientific creationism.

In the end, they compromised by agreeing to a policy that requires science teachers merely to acknowledge the existence of other theories. Although the case thus ended in something of a draw, the reappearance of the issue in the courts was a revealing reminder of how politics and pressure groups influence public education.

The rising respect given by politicians to the numbers and influence of creationists was shown when Ronald Reagan, several months before he entered the White House, responded to a question about evolution: "Well, it is a theory, it is a scientific theory only, and it has in recent years been challenged in the world of science and it is not yet believed in the scientific community to be as infallible as it once was believed."

Many scientists and science teachers were appalled. "Nonsense," said Niles Eldredge of the American Museum of Natural History. "No active geneticist, embryologist, systematist, anatomist or paleontologist doubts that life has evolved. What such biologists do argue about is how life has evolved."

The Science Council of New York City, with a membership of more than 1,000 science teachers, met at Rockefeller University in December for a symposium on creationism. A representative of New York City's Board of Education emphasized that in its jurisdiction only science and scientific theory and not scientific creationism, would be taught in science classes, whatever else might be studied in literature or other classes.

There are plentiful indications, however, that school boards in many communities have already made accommodations or can be expected to do so if pressure mounts. In Florida, a Tampa school administrator said: "The recommendation from our office was that scientific creation and other theories be taught in areas other than science, but the Board of Education chose to have them taught in science as well."

Political inroads into the curriculum are not new, and even flagship institutions above the public schools have not been immune. In 1798, a course in French language and literature, which had been instituted 10 years earlier when the French were allies, was eliminated from the curriculum at Harvard to assuage anti-French feelings. It was not revived until 1806 when students petitioned for its return.

In World War II, Nicholas Murray Butler, president of Columbia University, purged anything and anyone suspected of being pro-German. Many public schools followed a similar course.

For many years, textbook publishers, fearful of losing sales in the South, avoided criticism of slavery and referred to the Civil War as the War Between the States.

This is the background that makes science teachers nervous about the creationist drive. Some of them remember that in 1926, one year after the Scopes trial, George W. Hunter, former science chairman of DeWitt Clinton High School in the Bronx, deleted all mention of evolution from "Civil Biology", the textbook he wrote that had been used by John T. Scopes.

Stanley L. Weinberg, a science teacher in Iowa, who is involved in efforts to combat creationism, said that it was not until the early 1960's, when some prominent university scientists took the lead in a nationwide high school science reform movement, that evolution reappeared in science textbooks.

What worries science teachers now is that the supporters of creationism may be able to confuse the public by complaining that they are denied their democratic right to equal time for an allegedly rival scientific theory. Their strategy is to attack evolution as an "unproven" theory that is either invalid or, at most, of dubious value.

Dr. Wayne A. Moyer, executive director of the National Association of Biology Teachers, replied in a speech: "A theory often represents a brilliant flash of insight.... A theory is never proved but it is continuously scrutinized as new observations are added.... A scientific theory can never be proved--only disproved." The creationists, he says, in effect turn the argument around and say that evolution, because it cannot be proved in a laboratory, is not a science.

These science teachers fear that the activities of the creationists could result in the religious doctrine replacing scientific theory in some public school science classes. Experience suggests that textbook publishers might soon be affected. Texas, a major textbook buyer, has already determined that science texts covering evolution should "identify it as only one of several explanations of the origins of humankind."

In an effort to resist the influence of creationists, Mr. Weinberg has helped to organize Committees of Correspondence. Already in operation in 12 states, they enlists scientists, teachers and lay citizens to provide information and protective action at the local level. "I urge scientists especially to become involved because you are next," said David Kraus, a spokesman for New York's group, who is chairman of the Science Council's committee for scientific freedom.

Dr. Moyer translates the issue to the classroom level. Asked by a student whether he believes in evolution, he would, in turn, ask the student what he meant by "evolution" and by "believe." Suppose a student were to ask, "You know, humans coming from monkeys and stuff like that--are you really convinced?"

Dr. Moyer said he would reply: "I have faith or belief in the methods of science. That is, I trust them to tell me about the real world. This gives me confidence in the theory of evolution. As for humans coming from monkeys, I am confident that more than 5 million years ago there was a population of apelike animals which separated into two or more subpopulations. They continued to evolve during the intervening years to produce modern man and modern apes."

Mr. Moyer added that giving students the mental tools to make sense of facts "may not always win you plaudits from the community for you will be helping students to challenge authority." The creationists, he says, are aware of this and want to prevent their beliefs from being challenged. He concludes that, as professional critical educators, "there is no doubt that we stand in their way."

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ESTIMATION

Jeanne Edgar

Students play this game in pairs. The first player chooses two numbers from the "number pool" and multiplies them on the calculator and covers the product on the gameboard with a marker. Every product obtained must be used. Play alternates between players until one player has covered four products in a line in any direction (horizontal, vertical or diagonal).

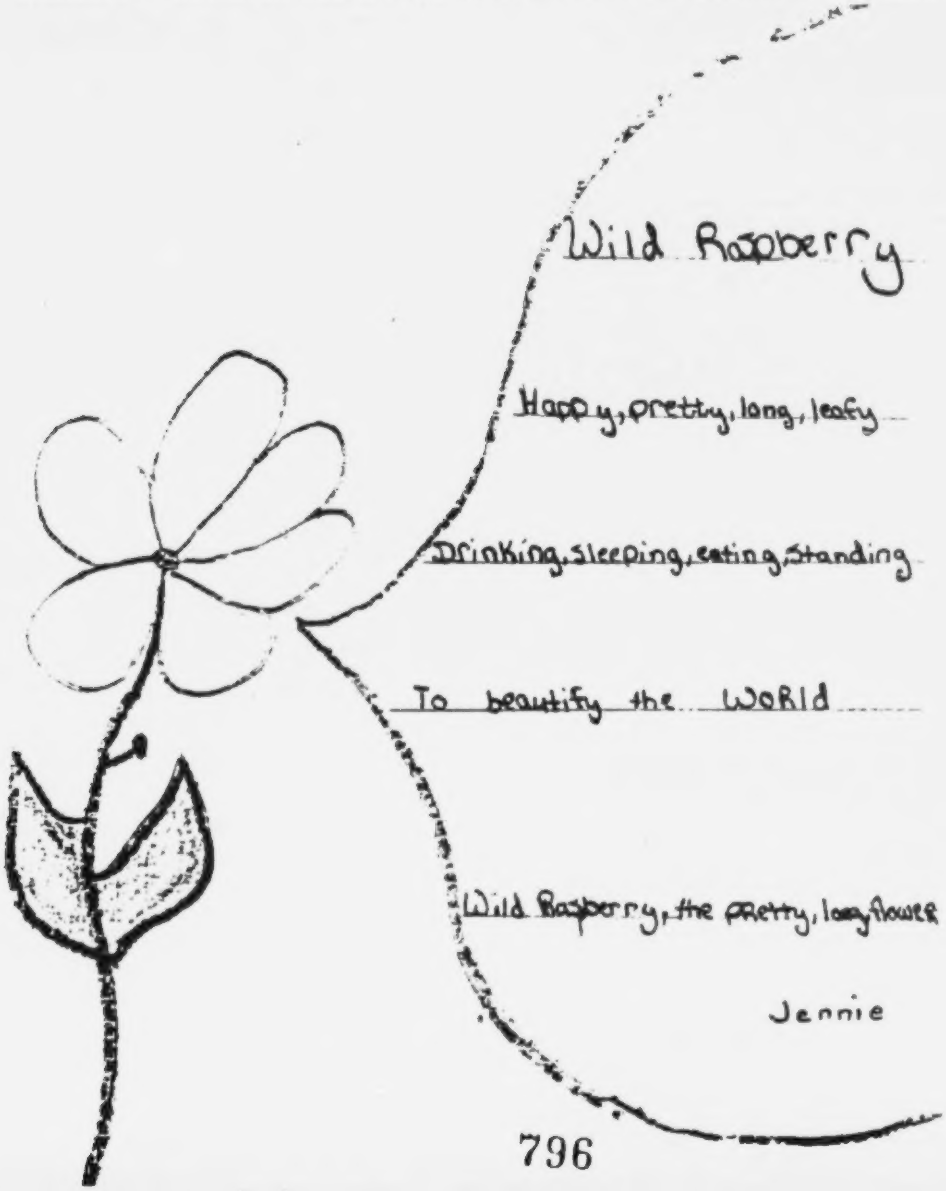
9 61 29 41 7
19 53 11 21

427	1113	477	671	231	63
779	133	1007	171	609	1281
451	209	1537	2173	549	551
399	1189	2501	1769	261	77
369	287	147	1159	3233	319
583	861	189	99	371	203

OUR INFLUENCE ON CHILDREN

Trudy Busen

In my brief encounter with working with young children, I have noticed the great influence we have on them. On many occasions children have commented on the shoes I wear, my perfume or the make-up that I use. They also notice the way you speak, write, walk and sit. Children can tell if you are truly interested in things that concern them. Since children are so observant and curious, it is very important for a teacher to set a good example and to be aware of the influence they have on their students. Children learn more from us than we intended to teach them.



Wild Raspberry

Happy, pretty, long, leafy

Drinking, sleeping, eating, Standing

To beautify the WORld

Wild Raspberry, the pRetty, long floweR

Jennie

FREEDOM TO FAIL

Helen L. Miller

As a kindergarten teacher, I find it most disconcerting when the four and five year old children in my classes are afraid to attempt new tasks for fear of failing. Every adult knows from experience that the things one learns are the result of failures, not successes.

Perhaps we as teachers are too anxious to praise success. It may be that we feel this will act as a motivating factor for underachievers. Perhaps we need to reassure ourselves that we are good teachers. Perhaps this is something that is innate in our very nature--to laud success and abhor failure.

In any case, how can a child attempt new challenges if he thinks that he might fail? How much better it would be if we, as educators, could bring ourselves to reward effort, rather than success!

I have found so many opportunities each day in my classroom to say to a child, "That's an interesting way that you did that problem. If you tried it another way, what would your answer be?"

I have also found that there is not always one right answer. Simply because the book has one answer, that does not mean there is no other answer that could be correct.

The pictures that book companies use in their workbooks and mimeograph materials are particularly deceptive. Is it a dog, a wolf, or a fox? Is that a duck or a goose? Do you call that a zink or a sink? Do you eat hot dogs, frankfurters or sausages? The author of a basal series may come from a section of the country where one drinks pop instead of soda! A child's vocabularly is rarely considered when some book companies develop materials for the classroom.

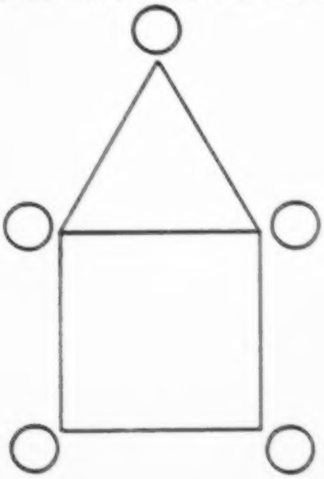
When my class was doing a page in a reading book which involved finding and marking all the pictures of things that began with the sound of the letter "f", one of the children marked a picture of a girl. When asked what pictures he had marked, he pointed to the girl and said, "That's a friend!" I could easily have damaged his self-image and discouraged any further effort by saying, "That's wrong. Girl begins with a "g"." But of course he was right!

Children want to learn. They want to achieve. Why can't we as educators build on this instead of discouraging achievement?

THE NUMBER HOUSE

Vicky Sugent

Place the numbers one through six in the circles in such a way that the sum of the numbers on the triangle is equal to the sum of the numbers on the square. Can you find more than one solution?

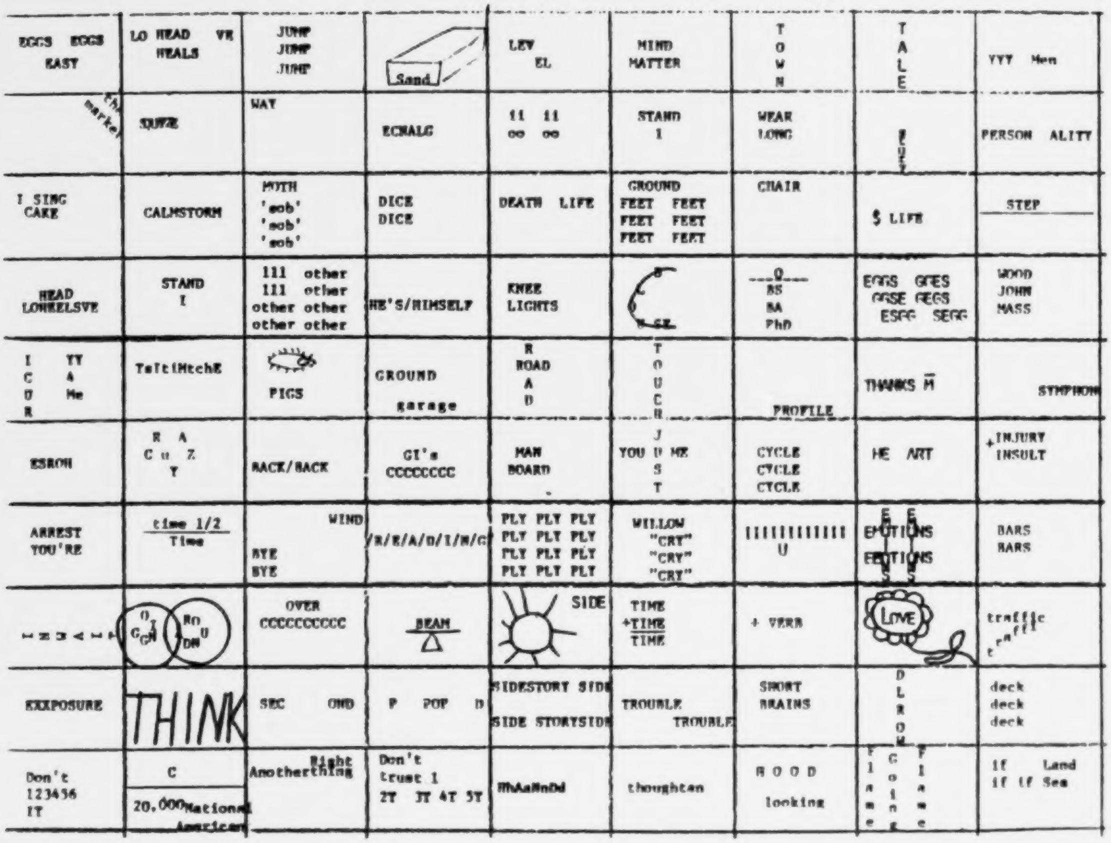


FUNNY WORDS

Bob Williams

Each square is a puzzle. Determine what the words mean and how they fit together and you will have a common word, phrase or description.

Example: eggs eggs
easy
is "two eggs over easy".



EGGS EGGS EASY	LO HEAD VE HEALS	JUMP JUMP JUMP	Sand	LEV EL	MIND MATTER	T O W N	T A L E	YYY Men
the market	SQUZE	WAY	ECNALG	11 11 ∞ ∞	STAND 1	WEAR LONG	[illegible]	PERSON ALITY
I SING CAKE	CALMSTORM	MOTH 'sob' 'sob' 'sob'	DICE DICE	DEATH LIFE	GROUND FEET FEET FEET FEET FEET FEET	CHAIR	$ LIFE	STEP
HEAD LOHEELSVE	STAND I	111 other 111 other other other other other	HE'S/HIMSELF	KNEE LIGHTS		O BS BA PhD	EGGS GGES GGSE EGGS ESGG SEGG	WOOD JOHN MASS
I YY C 4 U Me R	TaItiMtchE	PIGS	GROUND garage	R ROAD A D	T O U C H	PROFILE	THANKS $\bar{M}$	SYMPHON
ESROH	R A C u Z Y	BACK/BACK	GI's CCCCCCCC	MAN BOARD	J YOU U ME S T	CYCLE CYCLE CYCLE	HE ART	+INJURY INSULT
ARREST YOU'RE	time 1/2 Time	WIND BYE BYE	/R/E/A/D/I/N/G	PLY PLY PLY PLY PLY PLY PLY PLY PLY PLY PLY PLY	WILLOW "CRY" "CRY" "CRY"	IIIIIIIIIIII U	E E EMOTIONS EMOTIONS S S	BARS BARS
[illegible]	O T G GH RO U DN	OVER CCCCCCCCCC	BEAM	SIDE	TIME +TIME TIME	+ VERB	LOVE	traffic traffic
EXXPOSURE	THINK	SEC OND	P POP D	SIDESTORY SIDE SIDE STORYSIDE	TROUBLE TROUBLE	SHORT BRAINS	D L R O W	deck deck deck
Don't 123436 IT	C 20,000 National American	Right Anotherthing	Don't trust 1 2T 3T 4T 5T	MhAaNnDd	thoughten	R O O D looking	Flame Going Flame	if Land if if Sea

Note: If your students develop any "funny words", particularly in a subject content area, Bob would be interested in adding them to his collection. Just send them to us and we'll pass them on to him.

OBSERVATIONS OF A CHILD ON A GLIDER

OR

A THREE-YEAR-OLD SCIENTIST

Jan Douglass

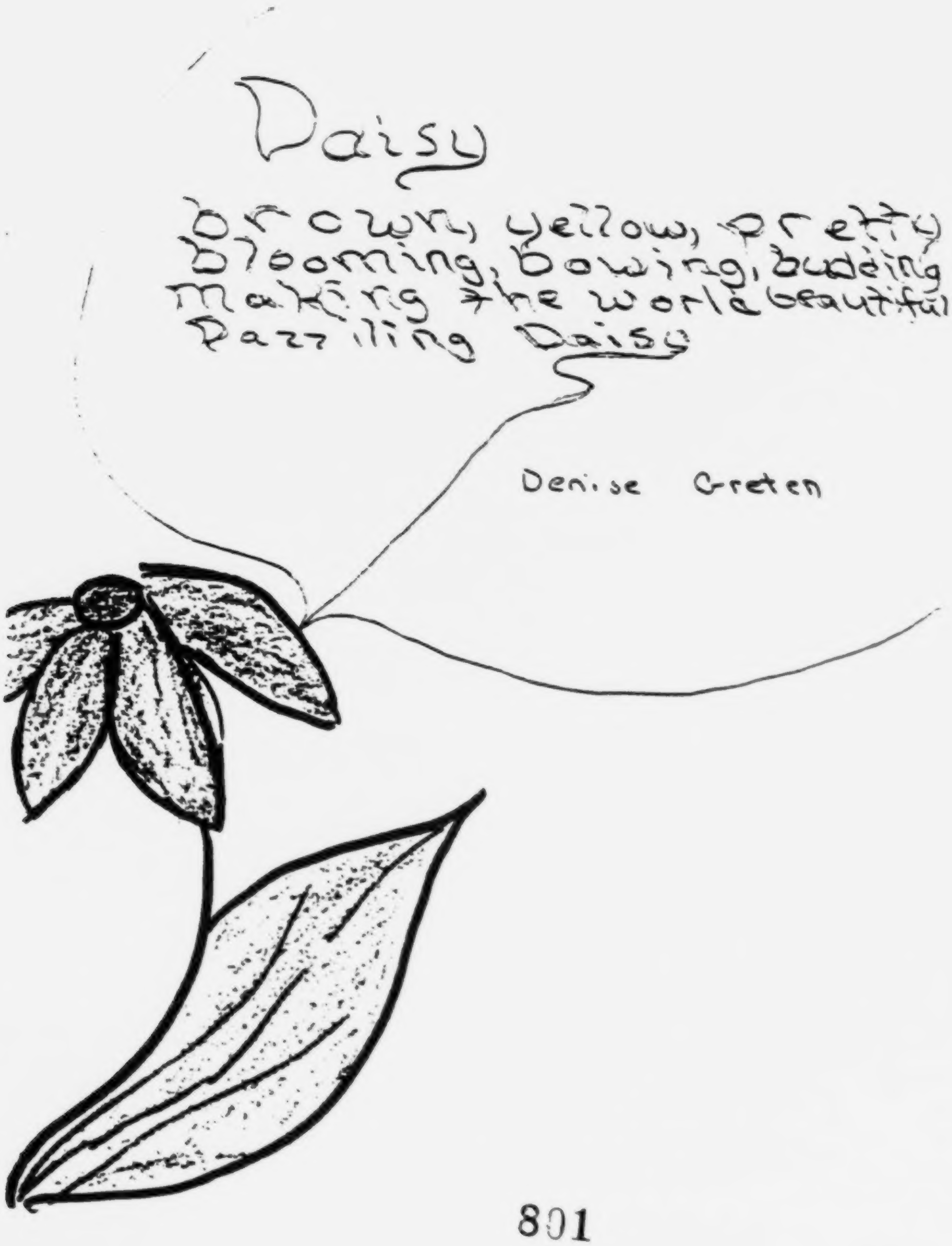
With the coming of spring, activity in our backyard picks up and this year I found myself not just looking but watching what was going on.

One of the newcomers was my daughter's friend who is age three years and eight months. She came over to play on the swingset and had no problems with the teeter-totter, slide or swings, all of which she has on her own set at home. However, our set has a glider, which presented a problem for her as she could not make it move while sitting in it.

First, she tried moving her body and legs as one would to operate a swing. When this failed to cause movement, she moved to a swing and tried the body and leg movement to make sure it worked there. Then she returned to the glider and tried again.

Having failed to move the glider, she then tried pushing on the floor panels with her feet and pulling on the poles with her arms as with a teeter-totter. Once again, when the glider failed to move, she moved to the teeter-totter to check out her movements. They worked on our teeter-totter, but failed to move the glider when she returned there. Her next step was to go to her own yard to try the movements on her own set.

Having confirmed the "correctness" of her movements on her own teeter-totter, she returned to try them again on the glider. This time as she stepped on the floor of the glider and held both glider poles, the glider moved from side-to-side. She continued to hold the side bar and move the glider by standing and swaying her body. Once she got up a bit of momentum, she tried to sit down and transfer back to body motion like in a swing. When the glider stopped, she went back to holding the side bar and standing up to move the glider. On this particular day, this was as far as the "experiment" went, but I was able to observe her for the next three days when she was on the swingset. She continued to use the side bar to begin motion and then let go to hold both poles and stand up to make the glider move. I am intrigued and fascinated that she has shown no signs of frustration or fatigue and returns to the task every chance that arises.



Daisy

brown, yellow, pretty
blooming, bowing, budding
Making the world beautiful
Dazzling Daisy

Denise Greten

THINKING

Pat Holtgrave

Here is a "test" of sorts that's been making the rounds. (I take no credit for it--I merely picked it up, worked it and had a great time doing it. Credit is given to: AHA Thinking by Morgan Worthy. Nelson Hall, Inc., 324 West Jackson Boulevard, Chicago.*) Maybe some of you will enjoy taking a stab at it.*

THE FORMULA ANALYSIS TEST

Validity studies indicate that this is not a test of intelligence, but it is a test of at least one kind of creative or flexible thinking. Do not be discouraged if you have trouble with the test; most people get fewer than half of the items on their initial try. Answer the ones you can and then stop. Try to remember the unsolved items and come back to the test from time to time and try to solve the items you have not yet solved. Answers may come to you at unexpected times. We are lowering your temptations by not giving the answers.

Examples: (1) 3F = 1Y (3 feet = 1 yard)

(2) 4L.C. = G.L. (4-leaf clover = good luck)

1. M. + M. + N.H. + V. + C. + R.I. = N.E.

2. "1B. in the H. = 2 in the B."

3. 8D. - 24H. = 1W.

4. H.H. & M.H. at 12 = N. or M.

3P. = 6

6. 4J. + 4Q. + 4K. = all the F.C.

7. S. & M. & T. & W. & T. & F. & S. are D. of W.

8. A. + N. + A.F. + M.C. + C.G. = A.F.

9. T. = L.S. State

10. 23Y. - 3Y. = 2D.

11. E. - 8 = Z.

12. 8P. = 1G.

13. C. + 6D. = N.Y.E.

14. S.R. of N. = 3.

15. A. & E. were in the G. of E.

16. My F.L. & South P. are both M.C.

17. "N.N. = G.N."

18. N. + P. + S.M. = S. of C.

19. 1 + 6Z. = 1M.

20. B. or G. - F. - M. = O.

21. "R. = R. = R."

22. AL & J.G. & W.M. & J.K. were all A.

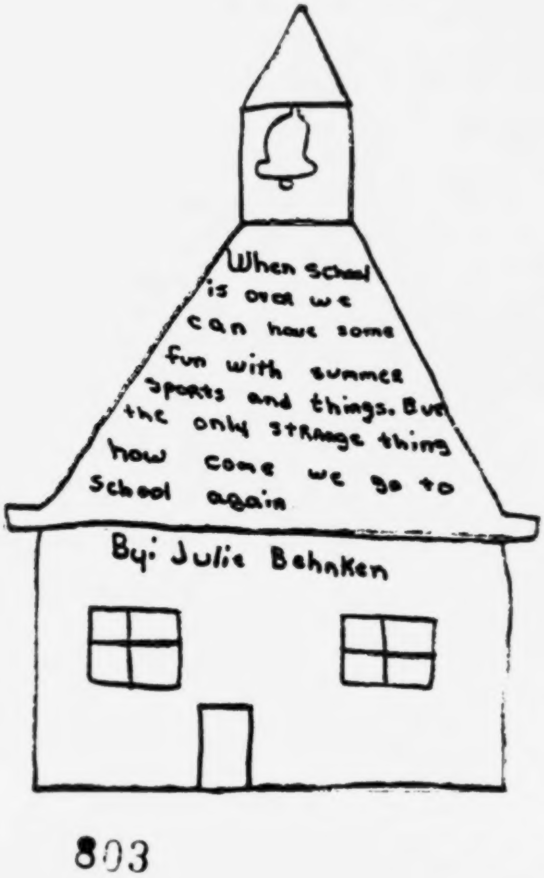
23. N. + V. + P. + A. + A. + C. + P. = 1P. of S.

24. S. + H. of R. = U.S.C.

25. P. & N. & D. & Q. & H.D. are all C.

26. Y. - S. - S. - A. = W.

27. Y. + 2D. = T.



When school
is over we
can have some
fun with summer
sports and things. But
the only strange thing
how come we go to
School again

By: Julie Behnken

CREATIVITY--IN A WORLD WHERE THE WHIRL IS KING

Fred M. Hechinger

"How can the spirit of inventiveness be revived?" That was the question put to an assembly of scholars and university presidents in a recent "Symposium on Creativity" sponsored jointly by the Library of Congress and the Carnegie Foundation for the Advancement of Teaching. Ernest L. Boyer, the foundation's president, posed the question, adding his suspicion that the universities "are tired" and their leaders are "preoccupied with the politics and management of education," leaving little room for creativity.

Defining creativity, or documenting its decline, is not easy. But academic observers are able to cite, as illustrations of their concern, the fact that fewer promising students enter graduate studies. They point to a growing tendency of engineering students to take lucrative jobs instead of moving on to advanced academic work. They are alarmed by the decline in the number of the best and the brightest who opt for advanced mathematics. They see potentially creative people on the campuses overburdened with administrative concerns. And they agree that, whatever creativity is, it counts--in school, in college, in science, in the arts, in industry and in government. And they are convinced that creativity is in short supply.

"Creativity," said Arthur Schlesinger Jr., the historian, "implies that leap of imagination and understanding which enables individuals to grow in dignity and purpose in a world where whirl is king. Creativity also implies the ability on the part of the creator to carry others with him in the endless quest for insight."

The symposium addressed to scholars the elusive questions, "What is creativity? How can it be nurtured?" Here are some of the answers:

Jacob W. Getzels, professor of psychology at the University of Chicago, took as his model a group of 30 talented young artists preparing for careers in the arts, from painting to industrial art, at the highly selective School of the Art Institute of Chicago. The first observation, he said, was the intensity of their motivation. They were "perfectly aware that theirs is a hazardous undertaking" without the clear-cut route to prosperity that awaits students in many other fields. "I paint because it's necessary," said one young artist. Instead of stressing monetary and social reward, the art students spoke most frequently of self-knowledge and self-discovery. "My message is to myself," one of them said.

The students' values, Professor Getzels observed, corresponded with those of creative young people in other fields, such as science, architecture and graduate research. The two highest values in all these groups were theoretical and esthetic; the lowest, economic and social. This makes them rather lonely figures.

Implicit in that observation are some of the reasons why modern institutions, including schools and colleges, are not very hospitable to creative people. These institutions, like society in general, tend to be suspicious of loners more interested in their own activities than in the people and the community around them. "The introduction of a new element into the intellectual universe," Professor Schlesinger said, "is a dangerous venture. Genius habitually provokes resistance." Many academic departments find it easier to live with pedants than with imaginative scholars.

"The difference between the imaginative scholar and the pedant is not that the one is better informed than the other--quite often the contrary is the case," said Professor Getzels. The difference, like the difference between the creative scientist and the technician or between the creative artist and the copyist, is that the latter are content to apply their skills to problems already defined, while creative minds seek to find the toughest new problems. "For the detective," Albert Einstein once said, "the crime is given.... The scientist must at least in part commit his own crime."

Gerald Holton, the Harvard physicist, spoke at the Washington symposium of "our failure of creativity, scientific and technical as well as political, in a world in which over half a billion people are near or at starvation level all their brief lives; where one-quarter of the world's scientists are working on the design and production of the next generation of weapons; where in our very backyard scientific literacy and productivity are declining."

Yet he also recalled that some of the most creative work was done under the most dismal circumstances. The astronomer Johannes Kepler sent his mind up to the stars while surrounded by the blood and death of the Thirty Years' War. Einstein, Fermi, Lise Meitner and Leo Szilard were "fiercely productive during their darkest days" while they fled the Fascism that threatened to engulf the world.

What emerges from this analysis of creativity's natural habitat is a concern that today's colleges and universities as well as high schools may be so preoccupied with imminent bread-and-butter problems, with the management of large and cumbersome institutions, with internal and external rules and regulations, that they give creative students a hard time. So, of course, do many parents who are more concerned with their children's success in the marketplace than with their creative ideas.

Perhaps the field was further muddied by the experiences of the 1960's, when some adults exploited the youth rebellion by hailing as creative genius much that was merely self-indulgence. But this mistake cannot justify any backlash against students who, as Professor Getzels puts it, are "problemizers"—who raise questions by identifying the tough problems. The problemizers are uncomfortable to live with. They make "systems" nervous. The symposium on creativity challenged the universities in the modern, systematized world not to forget the importance of unsystematic new ideas and of the students and teachers likely to generate them.

This article is reprinted in its entirety from the December 9, 1981 New York Times. Reprinted by permission.

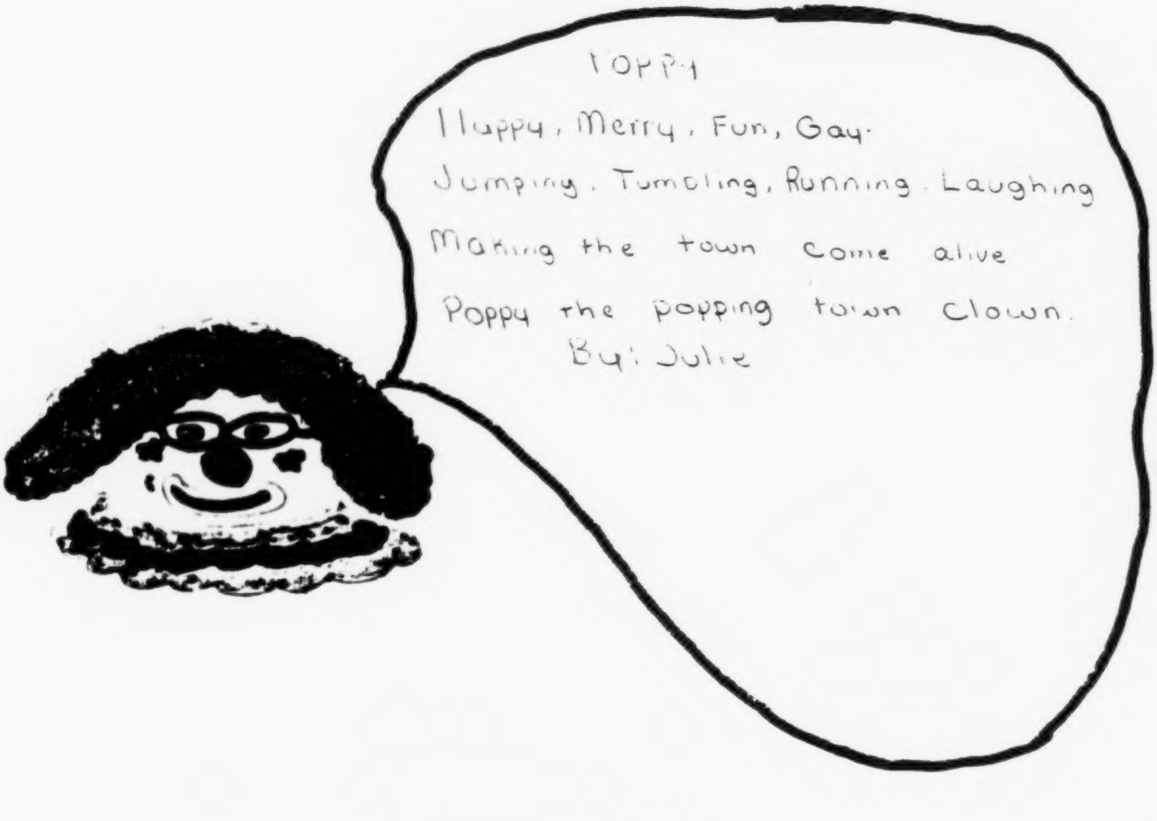
GO TO THE CENTER

Jim Beattie

This game requires that you start anywhere on the perimeter of a randomly numbered 9 X 9 square and work your way to the center of the square by moving vertically or horizontally along a numbered path so that the sum of the numbers along the path is equal to the number in the center of the gameboard.

9	2	7	5	8	9	2	5	1
4	6	9	2	5	6	1	7	1
3	5	7	4	3	7	4	3	2
4	1	3	8	2	0	5	8	2
8	2	8	9	25	1	7	2	9
6	4	2	3	5	8	6	4	7
5	4	1	0	6	4	2	3	3
8	2	1	9	9	1	7	0	9
7	3	6	5	2	5	1	8	6

(Note: asking students to construct different gameboards to be used for the same purpose would be a interesting and totally different task.)



Poppy

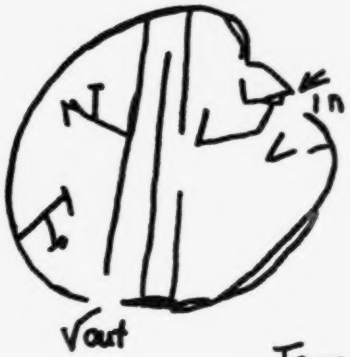
Happy, Merry, Fun, Gay.
Jumping, Tumbling, Running, Laughing
Making the town come alive
Poppy the popping town Clown.
By: Julie

CHILDREN'S SPACE AND MAZES

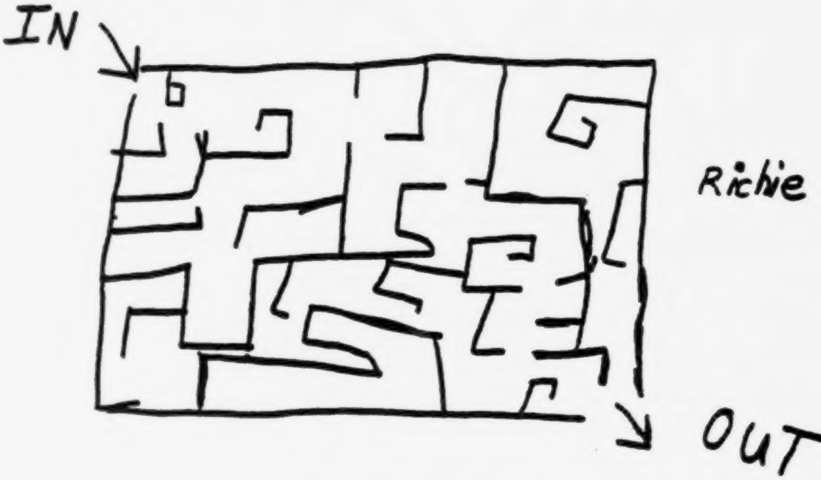
Mary Beth Peterson

Mary Beth Peterson's second grade class at Holy Rosary School, Fairmont City, Illinois recently did some work with space and mazes. As a result, they produced a little booklet entitled "Grade Two Makes Mazes."

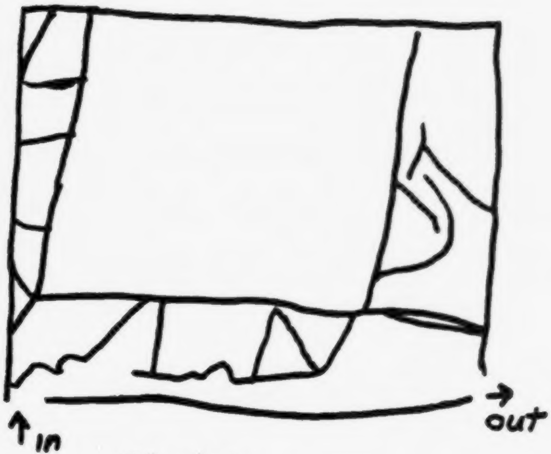
Those of us interested in observing children's thinking found them very interesting. Take a long thoughtful look and see what you think.



Jerry



Richie



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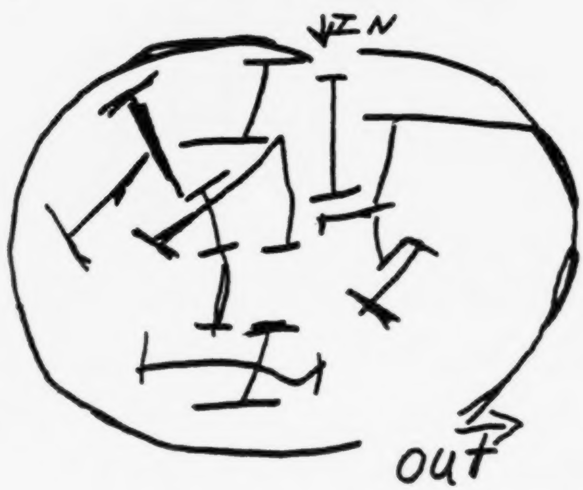

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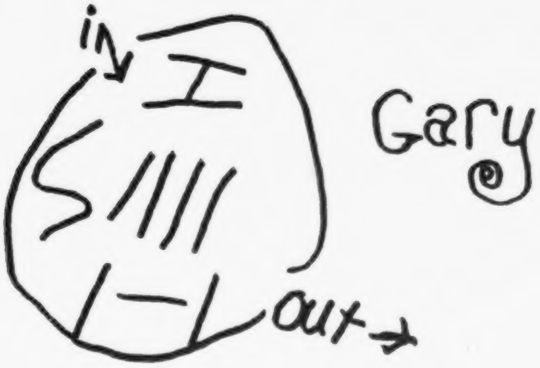

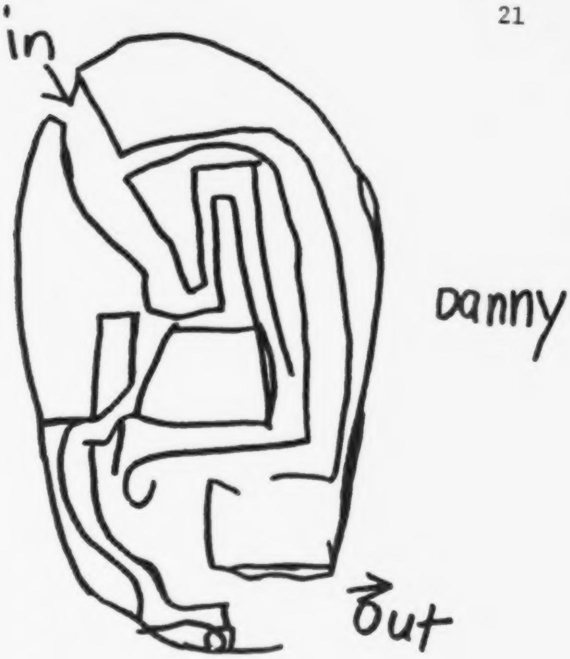
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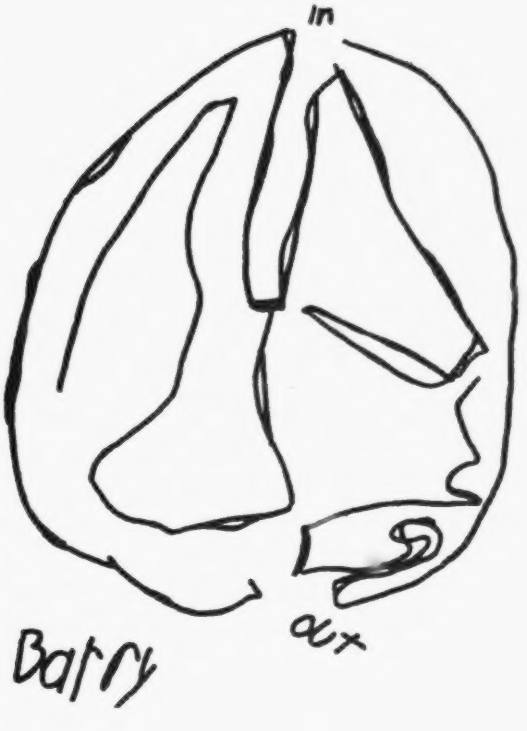
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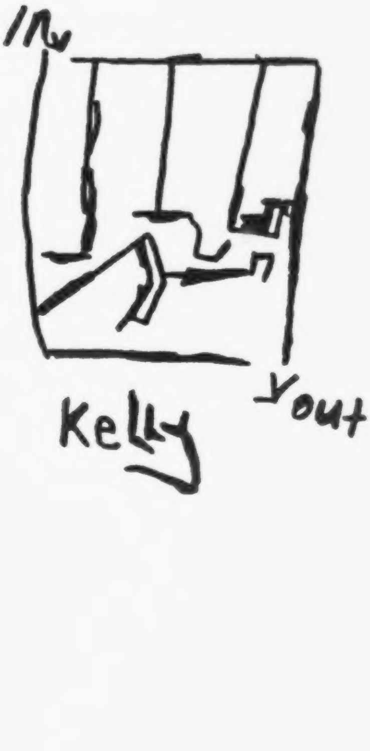
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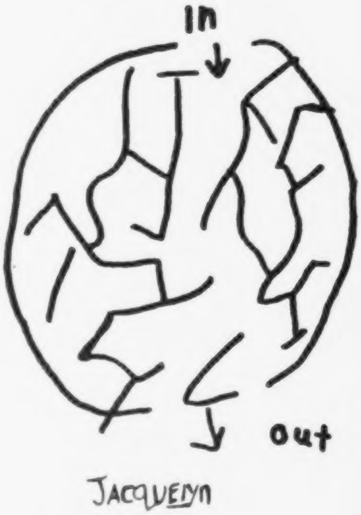
Kelly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JACQUELYN

Mary Beth suggests that if you're interested in doing some things like this - Young Children Learning Mathematics by Cruikshank, Fitzgerald and Jensen has some good ideas.

REPEATING DECIMALS

Jeanne Edgar

Repeating decimals are interesting and fascinating. When I teach repeating decimals, I do not just have my students work a variety of problems from the book. We do them in groups at the board. All the sixths are done at once, all the eighths are done at once, etc. Then the students look at the results and find what similarities there are. Soon the students are able to predict the number of digits in the repeating decimal before working it. They can also predict the answers of the rest of the sixths or eighths without working them.

Below are some samples. Remember that all fractions must be in simplest form.

$1/3 = .\overline{3}$
$2/3 = .\overline{6}$

$1/6 = .1\overline{6}$
$5/6 = .8\overline{3}$

$1/7 = .\overline{142857}$
$2/7 = .\overline{285714}$
$3/7 = .\overline{428571}$
$4/7 = .\overline{571428}$
$5/7 = .\overline{714285}$
$6/7 = .\overline{857142}$

Things to note about the 7ths:

All have 6 digits that repeat immediately.

All 6 digits are in the same order

All 6 digits are the same.

1/6 begins with 1, the smallest digit.

2/7 begins with 2, the next smallest digit.

3/7 begins with 4, the next smallest digit.

4/7 begins with 5, the next smallest digit.

5/7 begins with 7, the next smallest digit.

6/7 begins with 8, the largest digit.

$1/9 = .\overline{1}$

$2/9 = .\overline{2}$

$3/9 = .\overline{3}$

$4/9 = .\overline{4}$

$5/9 = .\overline{5}$

etc.

$1/11 = .\overline{09}$

$2/11 = .\overline{18}$

$3/11 = .\overline{27}$

$4/11 = .\overline{36}$

$5/11 = .\overline{45}$

etc.

The 11ths repeat after two digits. Both digits repeat. Answers are multiples of 9 and are in order starting with .09.

$1/12 = .08\overline{3}$

$5/12 = .41\overline{6}$

$7/12 = .58\overline{3}$

$11/12 = .91\overline{3}$

$1/13 = .\overline{076923}$

$2/13 = .\overline{153846}$

$3/13 = .\overline{230769}$

$3/13 = .\overline{230769}$

$5/13 = .\overline{384615}$

$6/13 = .\overline{461538}$

$7/13 = .\overline{538461}$

etc.

In the 13ths, six digits repeat using the pattern of .076923076923... or .153846153846...

$1/14 = .0\overline{714285}$

$3/14 = .2\overline{142857}$

$5/14 = .3\overline{571428}$

$9/14 = .6\overline{428571}$

$11/14 = .7\overline{857142}$

$13/14 = .9\overline{285714}$

Note the similarities between the 7ths and 14ths.

1/19 = .052631578947368421 (18 places)

1/17 = .058823529411746 (16 places)

1/89 = (43 places)

Notice that the denominator can sometimes indicate how many places. Places can be 1 less than the denominator or 1 less than ½ the denominator.

$1/21 = .\overline{047619}$

$2/21 = .\overline{095238}$

$4/21 = .\overline{190476}$

$5/21 = .\overline{238095}$

$10/21 = .\overline{476190}$

$11/21 = .\overline{523809}$

$13/21 = .\overline{619047}$

$16/21 = .\overline{761904}$

$16/21 = .\overline{761904}$

$17/21 = .\overline{809523}$

$19/21 = .\overline{904761}$

$20/21 = .\overline{952380}$

All of these have the same six digits in the same order. Each one starts with a different digit.
1/21, 4/21, 10/21, 13/21, 16/21, 19/21.

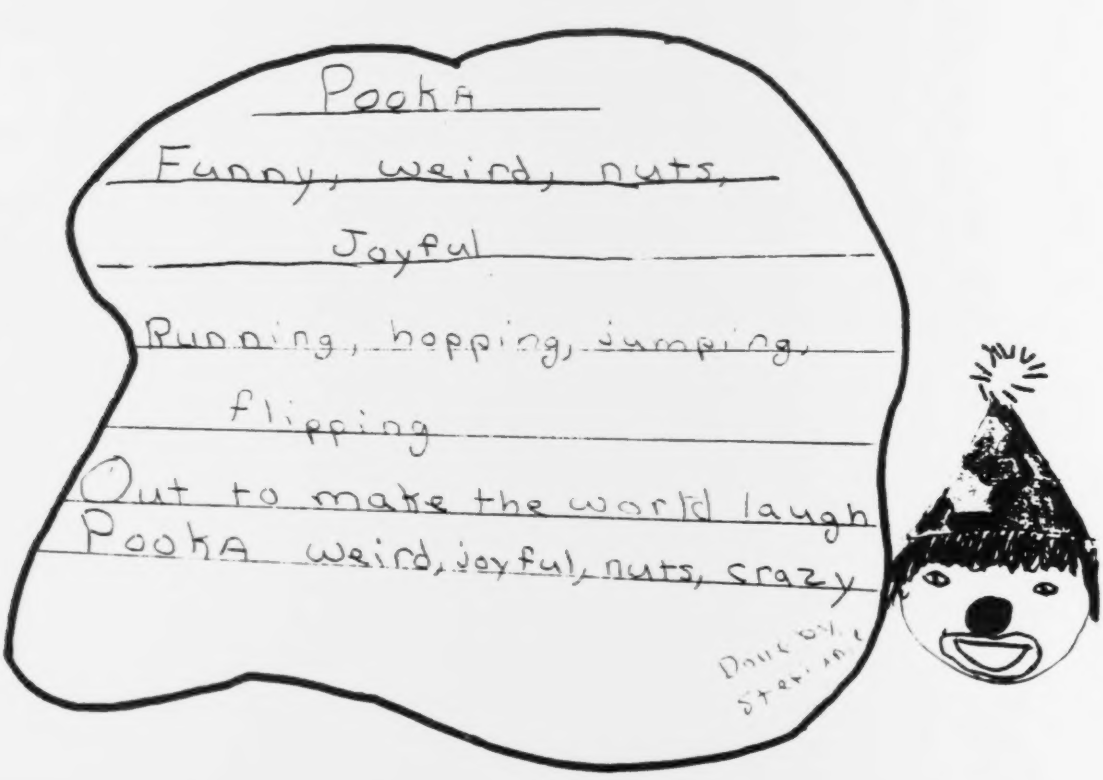
The same goes for these six fractions: 2/21, 5/21, 8/21, 11/21, 17/21 and 20/21.

TEACHERS' CENTERS--WHY?

Pat Holtgrave

Decision-making is not usually encouraged in schools. Teachers and students themselves don't like to spend the time necessary to allow for individual decisions. Because our society and our lifestyles are based on "FAST, FAST, FAST, FAST" and "DO IT NOW", it is easier to ask "How?" or "What?" and have someone give us the answer. It doesn't take as much time for someone to give that answer as it does for one to figure it out. It's much neater--you might make a mess working something out. No, it's much easier to ask and be given--it's how we've all been conditioned.

So, maybe then, this is a major purpose of a Teachers' Center...to teach us as students and teachers to think creatively so that we can teach others to do the same. Maybe a Teachers' Center is the first step for many of us to get away from "Ask and you will be given" and moving toward "Seek and you will find."



Pooka
Funny, weird, nuts,
Joyful
Running, hopping, jumping,
flipping
Out to make the world laugh
Pooka weird, joyful, nuts, crazy

Done by Stefanie

ONES AND FIVES

Sandy Urbeck

The object of this game is to get the highest total points by rolling five dice. Points are scored as follows:

1. Ones count as 100 points each.
2. Fives count as 50 points each.
3. Three-of-a-kind count as the face value times 100 (i.e. three 3's count as 300). Exception: three ones count as 1000 points.
4. Other combinations have no point value.k

Each participant rolls the five dice to obtain an initial score, based on the scoring rules. The participant can then re-roll any of the dice, up to a maximum of four, to add to his initial score. Successive rolls can be attempted until either of two circumstances occurs.

1. All of the dice have registered a scoring value (i.e. ones, fives, or part of a three-of-a-kind combination). In this case, the player has the option of continuing to roll the dice in an attempt to build a higher score or to keep the total achieved score as the round score and pass the dice to the next player.
2. If in a roll of the dice, no die registers a scoring value, then all preceeding point totals for that round are lost.

Therefore a player is in the position of a) minimizing risk and potential scoring or b) maximizing risk and potential scoring or c) a combination of the preceeding two strategies.

To begin the game, each player must score a minimum of 300 points in one round. If he does not do this, his round score is lost. After achieving it once--only 300 points, any additional round has a minimum of 50 points.

TEACHER LEARNS LESSON IN CLASSROOM

Colleen Hartry

Once, a long time ago, I came to my first teaching assignment in the inner city of Los Angeles. The children who were to meet me had been processed through that vast bureaucracy that is Los Angeles City Schools, and labeled Educably Mentally Handicapped (mildly retarded).

It was what I had chosen to do. Degree in hand, I even thought I was prepared. Countless professors had said that intelligence was fixed at birth. Within a given range, it might vary a little, given proper circumstance. This was very recent thinking, the most modern and enlightened.

I spent a full week before school was to begin, preparing my first classroom. There was a live rabbit and brightly colored learning games. Simplified reading series about racing cars and lions filled our bookshelves.

The excitement of meeting my very first students was only exceeded by my hope of teaching them what I thought they must surely need to know.

My principal explained these children had no physiological damage, only meager initial endowment. They were what they were and would always be.

"They are coming to you from regular classrooms, where they have not succeeded. Your children are the isolates of the school. You may have to work very hard even to make them want to come here. There may be behavior problems, too. Good luck," she said.

With a growing sense of responsibility, I eagerly awaited my students' arrival on that first morning of my teaching career.

Then I met my children.

There was Angela, age 8, a small quiet child with the biggest brown eyes I have ever seen. She was to arrive late each morning as she had full charge of her baby sister.

Carolyn and Carl, the twins, stopped at the nearby market each morning to breakfast on potato chips, and sometimes went off to other adventures, failing to arrive at all.

Max, whose "real" mother and father "didn't have him anymore," was at age 9 in his 11th foster home. Van, who had attended school for only 12 days of his 10 years, ran crying after his mother each time she dropped him off at our door.

Rica, a bubbling brunette, tiny and mischievous, could not tell me her address and phone number at the age of 8 but shared her longing for a "dog of my very own." Herman, also 8, mistrusted all adults and refused to speak at all.

Raymond, with the wide grin he couldn't suppress, not even for a strange new teacher, came shyly in and took his seat. Michael, with eyes that betrayed little curiosity, failed even to size up his new teacher as he came bumping loudly into the room. The others would register and enter later, a note from the office said.

I remember those first days and weeks so well because I wanted to give them so much, and they responded so little. Mostly lacking was enthusiasm. They didn't seem to care or to realize how important was this business that we had before us. I tried so hard to teach them, but they resisted learning.

Sometimes Michael of the incurious eyes would fall asleep in class, while Carl and Carolyn whispered to each other in a secret twin language. Van, whose mother had been persuaded not to escort him all the way to class, frequently had a tear suspended halfway between his cheek and his chin. Herman's main activity seemed to consist of gazing out the classroom window, while Rica and Max hurled whispered epithets at each other along with promises to "get you after school."

None of it was working. All the weeks of planning. All the things I'd brought in for them to touch and see and feel failed to stimulate them into wanting to learn. Not one lecture I'd ever heard, nor book I'd ever read had prepared me for this. There has to be a way to make them hear me, I thought. But how?

At last in my frustration, I put aside the zeal that only those just entering adulthood and wanting to make a difference can feel. I simply began to learn to know my children.

Instead of talking to them, I began to listen and to learn, myself. Very slowly we began to know each other. Even to trust a little. I felt guilty. I should be teaching them shouldn't I? Isn't that what a teacher is for?

And then a curious thing began to happen. My children began to open, like flowers. It was almost as if when we were finally able to make the connection as human beings, everything else began to follow.

The children began to respond and there grew between us a bond of affection and goodwill. As they talked and knew that I was really listening, we started to share. They began to ask questions about the very things I had so desperately tried to stimulate artificially in the beginning. It was very slow, achingly so, for all of us. The children tried so hard to think that I could feel it. Days passed into weeks and months and all of us grew together.

Angela learned to turn a part of her talent for nurturing onto herself, and she began to read, for the first time in her 8 years. Her big brown eyes held a new sparkle. Carolyn and Carl managed to arrive each morning ready to learn. Eventually, they shared the reason for their earlier failures to arrive at school. "We used to be dumb, and now we're not," they said. They proved it by advancing two years in their reading level that school year.

Max, who needed so much to have it proved that someone loved him, ran away one midnight from his 11th foster home. His foster parents had been warned that this was his pattern and that if it happened again he would be taken away from them, too. The police found him at 1 a.m., pounding on our classroom door and calling my name. I will always have to live with the knowledge that I was not there for him that rainy night. His new family and I were able to convince the courts, however, that this time, he had run to something. And so, he was allowed to remain with them and with us. Max, too was able to bring his academic level up more nearly to his age.

Van, the boy who'd been too scared even to stay in class, became our office monitor and a team captain, proudly explaining the rules of sockball to all our new enrollees. Rica, still not the mistress of a longed-for dog, was sure our rabbit loved her best of all.

I was privileged to keep these same children together for three years. After a while there was some startling progress in some--those who had enough courage, from somewhere, to dare and to keep on trying.

It was very hard. Perhaps they had just been born once and were simply there. Maybe they just sat and stopped thinking and seeing. It seemed as if a veil had dropped over their eyes and was too heavy to lift. We made a great effort. Each of us and some of them did break through.

Sometimes, a miracle. A group of children began to read almost at grade level; haltingly, but the skill grew with the effort and with the reward of succeeding.

Soon I requested that my children be retested. Surely some of them had been given to me by mistake and would continue to grow and improve in a regular classroom.

The System spoke to me of time and of money and of waiting lists, but eventually my children were retested. More than half of them left our room for the regular class. The rest were too marginal I was told.

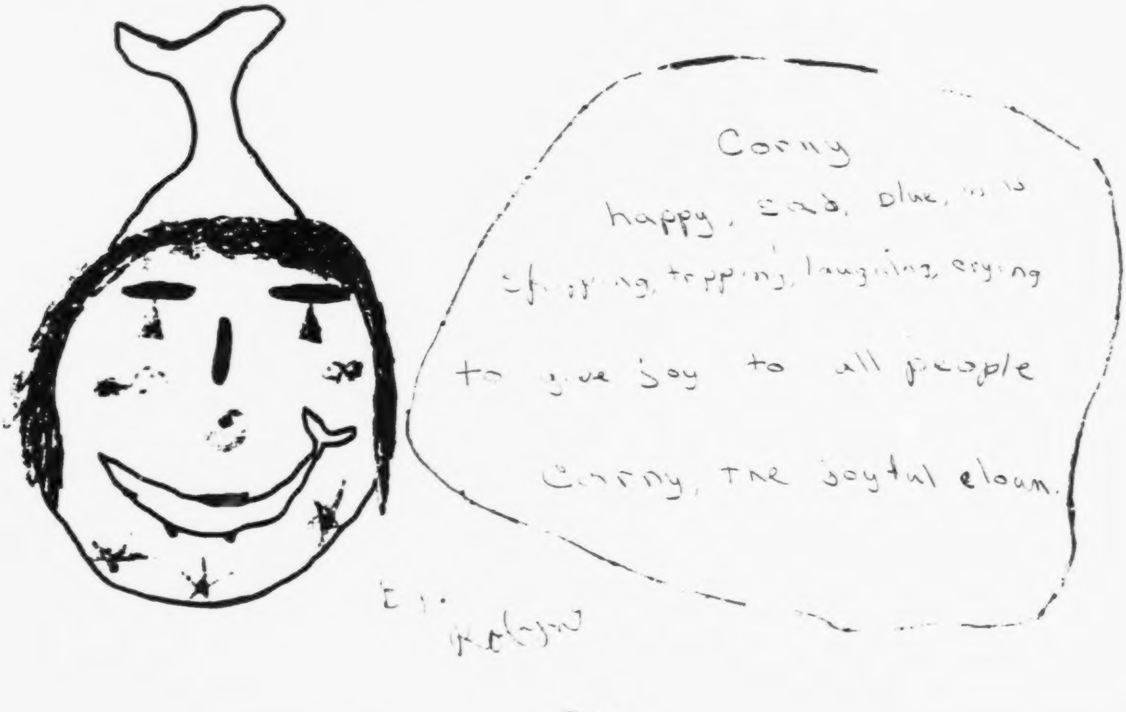
It was then that I began to wonder about Intelligence, to really question. Fixed. That word bothered me the most. Given range--what is that? In other schools, in other years, I saw many other children grow. Always I wondered what made some of them so ready and others not.

Then I thought, it seems contrary to all nature, this idea of fixed, limited. Is it just a label we give in order to better define the world for ourselves, to make things easier to organize? Isn't every other living thing becoming? Doesn't every other living thing have an innate capacity to blossom. Surely human beings must have this ability, inside, however dormant. Could we be limited and the others not?

What if human intelligence were not fixed or limited in any way? Except when we stop trying in those areas in which we do not succeed initially and think ourselves dumb. Could that be the only limit? The one we impose on ourselves through our own mistaken assumption.

Is our own fear; our lack of trust and faith in ourselves the only thing that is holding us back? What would the world be like if that were true and we knew it in our hearts?

This article, from the Los Angeles Times, is printed with the permission of the Belleville News-Democrat, in which it appeared on March 25, 1981.


Corny
happy, sad, blue,
skipping, tripping, laughing, crying
to give joy to all people
Corny, the joyful clown.

PATTERNS

Helen Miller

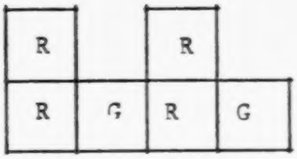
One of the most difficult tasks I have encountered in teaching kindergarten is that of helping the children understand patterns. This year we have tackled the task in several different ways that seem to be successful for most of the children.

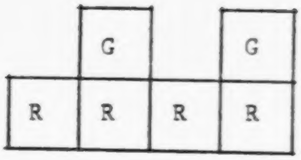
The first step was to have the children stand in a row—boy, girl, boy, girl, etc. After they recognized this as a pattern they stood in a row with one child standing, the next stooping, one standing, the next stooping, etc.

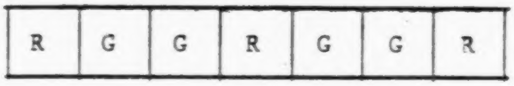
We then used objects which the children could manipulate, such as a toy car, a toy animal, a toy car, a toy animal, etc. I arranged the first few patterns, then the children took turns being teacher and establishing other patterns.

From using these manipulatives we went to bead strings. I set up simple patterns using only one attribute such as color, or size, or shape. The children were then to duplicate the patterns. The children approaching the concrete level of development were able to go on to develop patterns using two attributes such as one red round bead, one square blue bead, one round red bead, one square blue bead, etc. Or they would make a pattern such as two red beads, one green bead, two red beads, one green bead, etc.

The next step was to have each child take eight colored cubes. They were instructed to take eight cubes being sure to have two colors and the same number of each color. They were then to arrange those cubes into a pattern. Most of the children set up a red, green, red, green, alternating pattern. However, some of the children laid their cubes on the table in a straight line; some of them made a column of alternating colors. They were again instructed to create other patterns. Diagrams of the results follow:







Cuisenaire rods can also be used to develop the concept of patterns. Each child was again instructed to take eight rods, being sure that he had rods of two colors and the same number of each color. They were able then to construct patterns of color, such as red, black, red, black, and patterns of size, such as long, short, long, short. They went on to create other patterns using rods of three colors and sizes.

The last device that we used was dice. Each child took five dice. The object was to create a pattern of dots on the top of the dice, such as five dots, one dot, five dots, one dot, etc.

"Can you make a pattern on the side of the row of dice, while keeping the top pattern intact?"

"What is the total of the dots on each end of the row of dice?"

"Will you have that same total when you use only four dice, three dice, or two dice?"

"Will the same thing happen if the pattern on the top of the dice is changed to another pattern?"

In kindergarten this is an excellent opportunity for "teacher magic". Without turning the dice over teacher will be able to tell what dots are on the bottom of the row of dice!

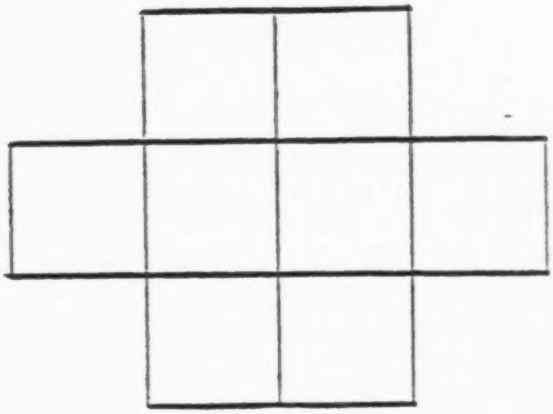
I have used these techniques with the whole class and in small groups. It was fun!

BASE TWO BRAIN TEASERS

Jim Beattie

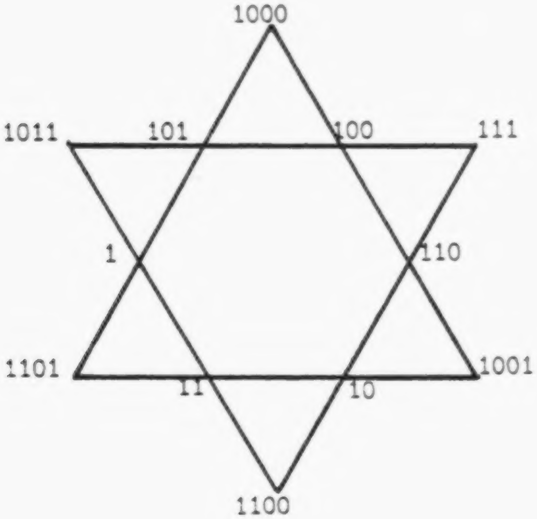
Square Arrangement

Place the numbers 1_{two} through 1000_{two} in the squares so that no two consecutive numbers will be next to each other horizontally, vertically, or diagonally.



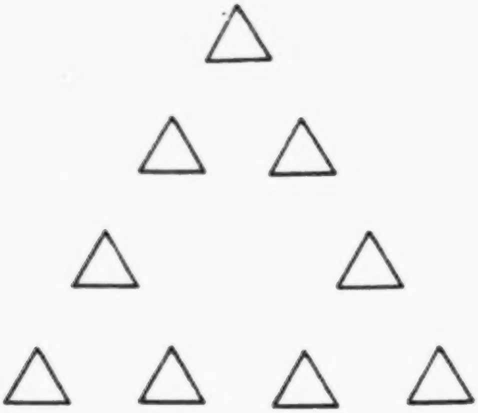
Magic Numbers

The figure below is unique in at least three ways. Discover as much as you can about this figure. (All numbers are written in base two.)

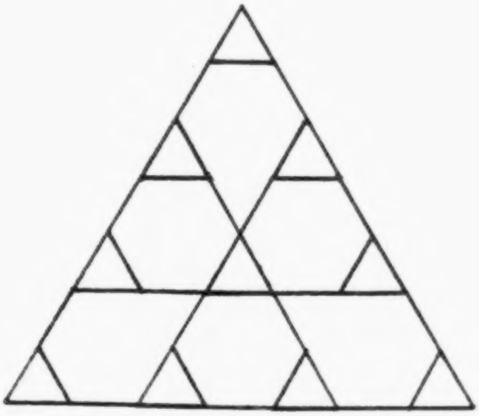

1000
1011
101
100
111
1
110
1101
11
10
1001
1100

Magic Triangles

Fill in each of the small triangles with one of the numbers 1_{two} through 1001_{two} . Use each number only once. The sum of the numbers on each of the three sides of the large triangle is 10001_{two}.

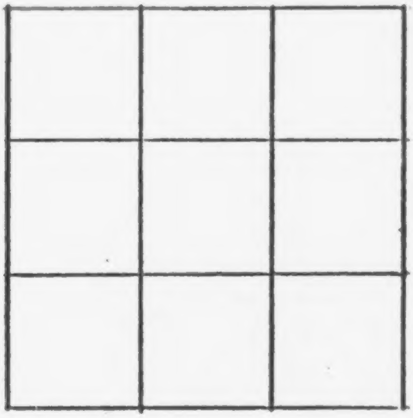


Fill in each of the small triangles with one of the numbers 1_{two} through 1010_{two}. Fill the triangles in so that the sum of the rows of three are the same, and the sum of the rows of four are the same.



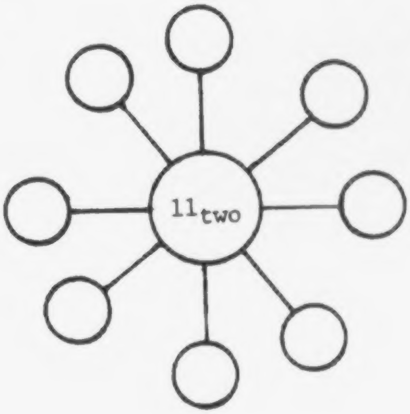
Magic Squares

Write the numbers 1_{two} through 1001_{two} in the squares so that the sums of each of the columns and rows is 1111_{two}.



Octopus

Write the numbers 1_{two} through 1000_{two} in the outside circles so that each line of numbers totals 1100_{two}.



ANSWERS*

Square Arrangement

	11	101	
111	1	1000	10
	100	110	

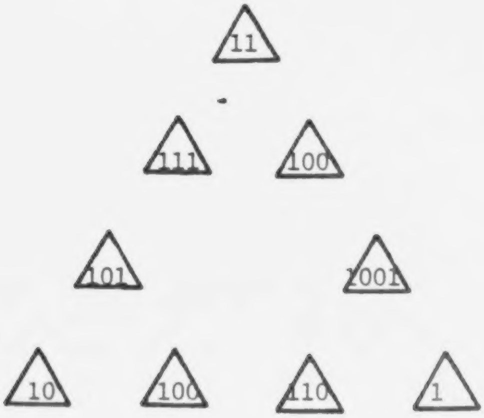
Magic Numbers

All little triangles add up to 10001_{two}.

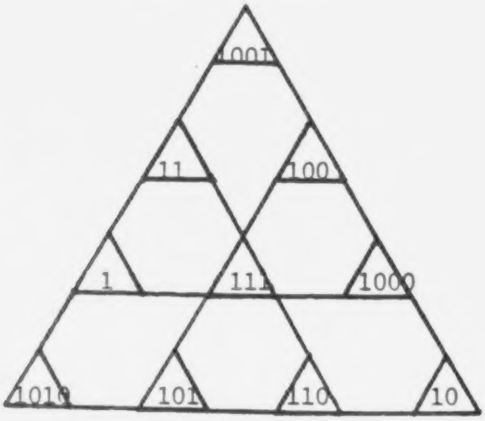
All large triangles add up to 110011_{two}.

The sum of the points of the big triangles is 11110_{two}.

Magic Triangles


11
111
100
101
1001
10
100
110
1

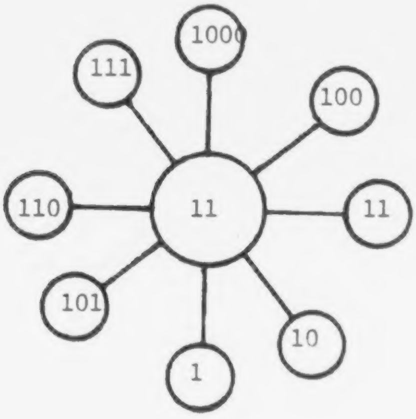
Magic Triangles


1001
11
100
1
111
1000
1010
101
110
10

Magic Squares

100	11	1000
1001	101	1
10	111	110

Octopus


1000
111
100
110
11
11
101
10
1

* All numbers are in base two.

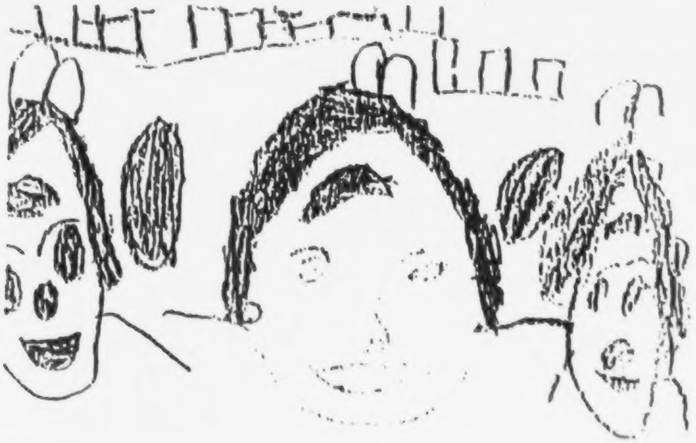
OBSERVATIONS OF CHILDREN'S ART

Deb Goalby

Frequently, children ask me for help in formulating ideas for an art activity they may be executing. Too often, children rely on me or someone else other than themselves for ideas. Perhaps the most difficult aspect of any creative endeavor is the formulation of a unique idea. As teachers or parents, we frequently instill or impose our ideas and thoughts on children, so much so that they become dependent on another for an idea, and actually believe that these "suggestions" are their own. How often have you done something as an example and have many class members imitate that very example?

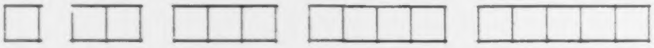
Children need encouragement to draw from outside stimuli, their environment and personal experiences. This drawing by Angel Pratt, a kindergarten student, is an example of a child's use of her environment in developing an idea. When asked to draw a picture, Angel looked around the art room, taking notice of a display of masks. She then drew a number of masks; however, they were originals, not copies of the display masks.

Children should be encouraged to visually express their thoughts, experiences and emotions. Some children obviously require more stimulation and motivation than others. However, having them produce carbon copies of our ideas is fostering dependence and false securities, rather than creativity and creative problem-solving.



CUTTINGS

BATC Participants

This week I read "Magic Counters" by Helen Jones from SEEDBED 8. To do the activity, my second grade class (learning disabled) cut rectangles out of squared paper. They needed a rectangle that represented each number 1-10. Ex: 

Some of the activities we tried were using four rectangles to make 16, three rectangles to make 12 and so on. We then worked to see how many ways this could be accomplished. Then we expanded the activity by pooling the rectangles and working together. The children seemed to be so excited to find many more ways to get the same sum. We recorded as many of them as we could find.

Other extensions we tried were taping the rectangles together to form one long rectangle down the hall. Then we made them into number lines. We marked each ten with orange and each hundred with purple.

This was a perfect lesson on tens and hundreds. It was super. Their regular classroom teacher remarked to me about the good carryover this activity had for the students. I know I would not have gotten this response from the children had I said, "Today we are going to work on number sentences," or "Today we'll have a lesson on tens and hundreds." Instead they were so open to the fun of the activities they learned in spite of themselves. And so did I!

Sandra Martinson

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I asked my homeroom class, "What does it mean to know something?" (This group consists of fifth graders and learning disabled children.) Some of the responses were:

"It means a secret."

"It means A's and B's and a scholarship and diploma."

"To hear it and say you know it."

"Smart."

"To learn."

"When you think about something to be sure, ask someone to be sure and then you'll know."

Sue Modro

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An idea I want to discuss with my high school geometry class concerns the definition of a straight line. On the surface of the earth is the shortest distance between two points a straight line?

Another activity I plan to use involves combinatorial properties. The problem is fairly simple but still unresolved. A traveling salesman wants to start out from Washington, D.C., visit every state capital, and come back to Washington, D.C. He can tell from the road maps the distance between any two capitals. How should he plan his itinerary so as to make the trip as short as possible?

Two quotes I wish to share: "The mathematician's patterns, like the painter's or the poet's, must be beautiful; the ideas, like the colors or the words, must fit together in a harmonious way...there is no permanent place in the world for ugly mathematics." (G. H. Hardy)

"Among progessional mathematicians, asking questions rates almost as high as answering them." (George Boehm)

Jim Beattie

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This week I have been helping with the 3 and 4 year old Bible School class at our church and one day we went on a Nature Walk. The teacher in charge had mapped out which natural sites we were to see within the block surrounding the church and I was "bringing up the rear" to prevent losing any of our little ones.

While the teacher was talking trees and flowers, the kids were finding fuzzy moss in the sidewalk cracks, bird egg remains on door sills, and collecting leaves, bits of wood and little pebbles. It occurred to me that even at the tender age of 3, we are planning "our" agendas and we're so busy following them that we can literally go around with our heads in the clouds (or so it might seem to a person 3 feet high looking up) while the kids live and learn on their own level.

One little girl had a bag of yellow leaves that she clung to and when the morning was over and her mom met her at the door and asked, "What did you do in Bible School today?", instead of saying "planting seeds" or "making bird wings and flying" or one of a dozen planned or prepared things, the little girl replied, "I found God's pretty leaves."

Jan Douglass

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One day I asked my five-year-old daughter if she could divide 28 marbles into two groups (we don't have any marbles). She sat for a moment, then got up and got my cotton balls. She counted them and moved them around a good bit. When she indicated that she was finished, we each had 14 cotton balls. She grinned and said, "Now I have a problem for you--can you make them hard like marbles?"

Vicky Schaefer

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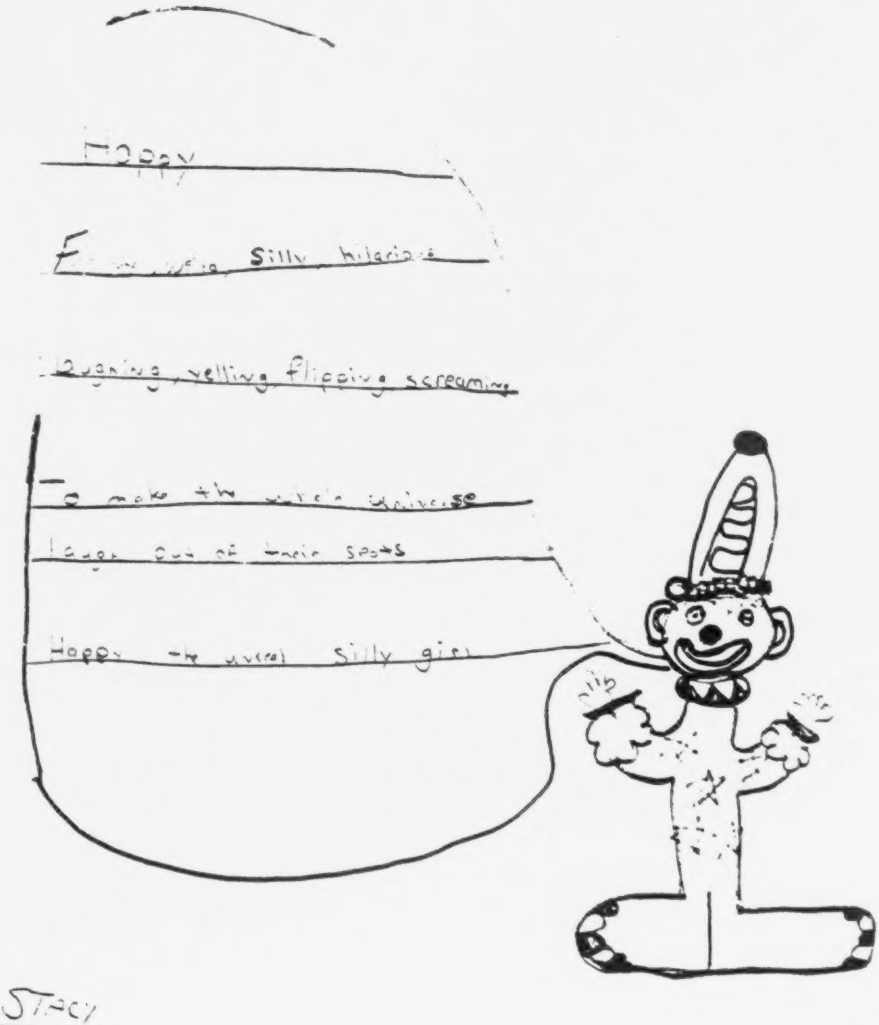
We recently had field day for all grades. This was my first exposure to competition (in front of age peers) in children of this age (5-6). It was a most emotional feeling. How bravely and with what confidence they all walked to compete. The sadness they returned with! Half wouldn't compete in the last two events (that half ironically were all 5 year olds--late birthdays). I am still aghast! There was but one team sport and five individual competitions--the same events for each grade and although each grade competed among itself, can you imagine a five year old on an obstacle course of bars, pits and hand-over-hands? I am furious! Can you tell?

My final observation deals with the various districts and systems. I have been involved in three different ones, each in turmoil at some point of my duration. I am fearful for public education. I truly feel it is strangling itself. It seems to me that if this country is returning to people control(?) why can't education? Why can't parents paint a classroom--why couldn't I weed a garden and why must a system strive so hard to be best, forsaking the reason it's there? It must be the end of the year or maybe Wonderland isn't quite the way Alice thought.

(name withheld for obvious reasons)


Happy
F[illegible] Silly hilarious
laughing, yelling flipping screaming
To make the whole universe
laugh out of their seats
Happy the [illegible] silly girl

STACY

BOOKS, BOOKS, BOOKS

Helen Miller

The hue and cry of most school districts today is--NO MONEY! At the present time I have in my kindergarten room a very expensive basal reading series that involves purchasing new workbooks for the children each year, a math series that also requires new workbooks each year for each child, a very expensive monthly activity series that was recently purchased for each kindergarten teacher, a social studies program, a health program, film strips and tapes for teaching phonics, and a reading readiness series.

As we approach the end of the school year, I look at all this material and wonder if any of it were really necessary. We have used all this material very little; in fact, we have to rush to fill in the pages of the workbooks in order for the children to take them home. Parents seem to expect to see workbooks completed in order to be assured that their child has acquired the skills needed to enter the first grade.

Many of my students have begun reading. Some have read as many as twenty books! We did not use the basal reading series. They dictated bus rules, safety rules and health rules to me and I wrote them down verbatim. They dictated stories and I wrote them down verbatim. We did a great deal of verbalizing and communicating. We read back what we had written down. We used language in any and every way possible. The children discovered that it took three letters to make the sound "cat". It took five letters to make the sound "three". When they asked about how to write down a word, I wrote it down so that they could copy it. We learned by doing!

Math seemed to make much more sense to them when it was necessary to find out how many children were present in order to equally divide the snacks. When we counted the days to Halloween and Christmas, it was more interesting than one of the pages in the math book. One day we had to find out how many flowers we could paint on our windows. We have eleven windows and can put five flowers on each window. By using the bead strings the answer was obvious. By using problems pertinent to the everyday world of a child and by using the bead string as a means of solving those problems, the children found that "math" was something useful and fun, not a mysterious something hidden between the covers of the math book.

As far as social studies is concerned, I find there is so much in the world around us that a special program is hardly necessary. We learned about Indians at Thanksgiving, about ourselves and our families at the beginning of the year; we celebrated the Chinese New Year. We learned Mexican songs that one mother had taught her kindergartener. One year one of the mothers came to school and made tacos from scratch for the children. Officer Friendly is also available from the police department to talk with the children about his job as a policeman.

Perhaps we have come to rely on printed materials to such an extent that we can not see the forest for the trees. There are so many resources available to all teachers that it seems like a great waste of funds to buy all these special programs to teach the basics. Why not use the money to hire more teachers in order to make the class size smaller?

I am certainly not advocating eliminating all books from school. We definitely need books. I do know that at the kindergarten level, learning is much more meaningful to the child when it is based on what is important to him, rather than basing it on what some adult a long way away in time and distance thinks is important.

MAGIC NUMBER

Joyce Mathes

This game is played with a deck of cards, with all the picture cards removed from it. You may use several decks of cards, depending upon the number of students playing. It is not necessary to have complete decks--a good use for all those "useless" cards laying around.

Shuffle the deck and turn the first card face up. This card becomes our "magic number".

Deal four cards to each player. The remaining cards are dealt into stacks of four cards each, to be used later.

The player must add, subtract, multiply or divide (or any combination) all four numbers on the cards in his/her hand to arrive at the "magic number".

For example, if our "magic number" was 2 and we were dealt a 4-1-5-3, we could add 5 + 4 = 9; divide by 3, 9 ÷ 3 = 3; and subtract 1; 3 - 1 = 2. Note that each card has been used only once.

If we were dealt a 10-7-3-8, we could add 8 + 7 = 15; subtract 10, 15 - 10 = 5; and subtract 3, 5 - 3 = 2.

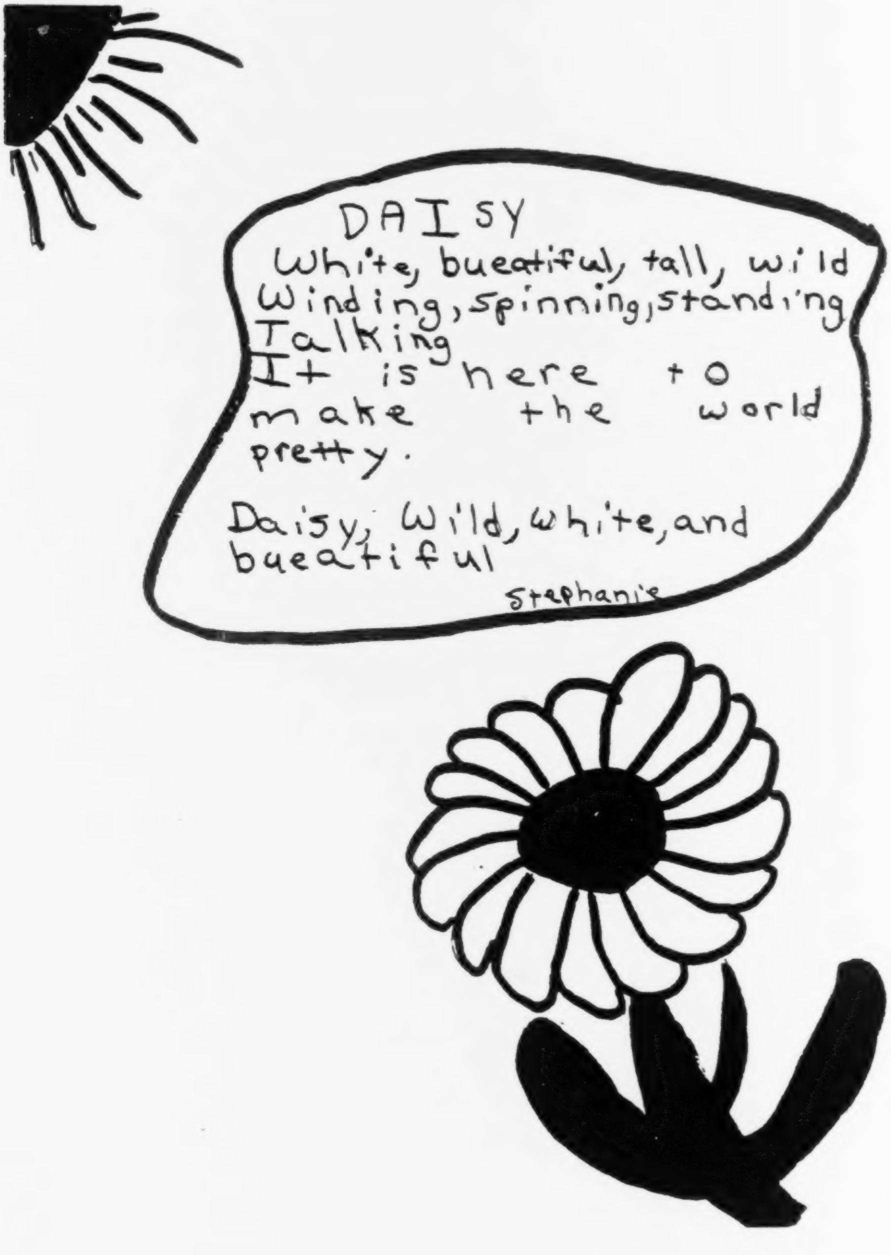
Other examples: 10-6-7-2 (10 = 6) - (7 X 2)
10-4-10-2 [(10 - 10)(4)] + 2

After the player has found the "magic number", (s)he is to write the solution down in case it is necessary to verify it later. (S)He then gets another stack of cards from the pile.

After the draw pile has been depleted, we then list on the board the numbers of the cards and the students' names who have not found the "magic number". The first player to find the "magic number" may then take the cards from that player. The player with the most cards wins.

I have limited the children to using whole numbers only. Any division must result in a whole number. For older or more advanced students, you could adapt the rules to include fractions, negatives, etc.

I have used this game with grades four, five and six and the children just love to play it. It doesn't take long for the children to realize that their pile of impossible cards really does have a "magic number". (Editor's note: a note to parents requesting broken decks would certainly insure an adequate supply.)



DAISY
White, bueatiful, tall, wild
Winding, spinning, standing
Talking
It is here to
make the world
pretty.

Daisy, Wild, white, and
bueatiful

Stephanie

LOOK AND THINK

Shirley Casey

This summer I took a very interesting new course, "The Psychology of Stress". One of the issues discussed was the relationship between personality types and stress/coronary heart disease. Type A personality and negative stress consequences (among them coronary heart disease) have been shown to be correlated. The mechanism is not understood, but there can be little doubt that Type A behavior is implicated in some way in heart disease.

A handout was made available listing the characteristics of Type A behavior. Take a look at it and see if your reaction to it was like mine.

Must get things finished once started.

Never late for appointments.

Highly competitive.

Anticipates others in conversation (nods, interrupts, finishes sentences for the other.)

Always in a hurry.

Uneasy when waiting.

Always going full speed ahead.

Tries to do more than one thing at a time, thinks about what to do next.

Vigorous and forceful in speech (uses a lot of gestures).

Wants recognition by others for a job well done.

Fast doing things (eating, walking, etc.).

Hard driving.

Holds feelings in.

Few interests outside work.

Ambitious, wants quick advancement on job.

Often sets own deadlines.

Always feels responsible.

Often judges performance in terms of numbers (how many, how much).

Takes work very seriously (works weekends, brings work home).

Very precise (careful about detail).

CRYPTOGRAMS

Pat Holtgrave

During the course of one Teachers' Center meeting, Dr. O'Brien presented us with the following cryptogram.

T FPU YTFY BYPR T CPP ZDH
FD VZ, VHUUPLXNZ, BYZ
WJ T CD CYZ, BYPR T'J
VPCTOP ZDH? TU'C DRNZ
NDKP WRO UYWU TC WNN,
UYWU JWQPC JP WEU UYP
BWZ T OD, TU'C DRNZ NDKP
WRO UYWU TC WNN, VHU
TU'C CD YWLO NDKTRF ZDH.

He asked us to work it before the next class meeting. I'm not a complete novice at working cryptograms, so I set to work, completing it and recording my thought processes as I worked. They were as follows: Method of Reasoning: Look over the sheet carefully. "T" is used as a one-letter word several times, thus "T" must be "I" or "A", the only one letter words in English. In looking thru the cryptogram I saw a "T'J". I could not think of any "A apostrophe" words so I determined that "T" must be "I" and therefore the "J" must only be a "D" (I would/could) or an "M" (am). I held that mentally for a minute and skipped to TU'C. I ran thru my mental list of contractions and could only think of IT'S as a contraction with the apostrophe before the final letter. Ergo, U = T, so I filled in all "T's" as "I" and all "U's" as "T".

Next I noticed a 4-letter word that began and ended with "T". I chanced that it was "THAT" and thus tentatively filled in "UYWU" as "THAT" and then I filled in all "Y's" as "H" and all "W's" as "A". Then in all the three-letter words that started with "IT' ", I tried an "S" to take the place of "C", successfully and thus substituted "S" for all "C's".

Looking at line one, there is a three-letter word beginning with "S" followed by a double letter. Logically, you'd put "E" there (SAA, SEE, SII, SOO, SUU) so substitute all "P's" with "E".

Line five has a three-letter word beginning with "A" followed by a double letter. The context of "That is a__" led me to try "LL", so I substituted "L's" for all "N's" and it seemed to work.

The last line has a two-letter word beginning with "S", so the "D" must represent "O" (SA, SE, SO, SU) so all "D's" became "O's".

Going back to my original contraction of I'M or I'D, I found a two-letter word starting with "A" so I decided "J" must be "M" rather than "D" because I figured "AD" wouldn't be used here, but I kept it marked as a possibility until I got to line six. "JP" had to be "ME", not "DE", so "J" is definitely "M".

In line seven, "OD" has been shown to be "O" and follows "I" (single word) and is followed by a comma, thus it must be a verb—"DO". I substituted all "O's" with "D".

"Line six--"MA_ES" follow "THAT--must be a verb--tried "K"--seemed to work and make sense so substituted "K" for "Q".

In line three, "CYZ" has already been determined to be "SH_". "E" has already been used in place of "P", so the only sensible vowel left is " "Y", thus I substituted "Y" for all "Z's".

Things are moving quickly now. In line one, "ZDH" is "YO_". It must be "YOU" so I substituted "U" for all "H's" and cleared up several words.

In line two, "BYZ" stands for "_HY". The sentence is a question, so "B" must equal "W" (why).

In line one, "BYPR = WHE__." Common sense tells me to try "N" for "R". It works everywhere. In line five, "LO_E must be "V" for the "K" (love makes sense in the context, so I substituted all "K's" with "V".

In the last line, "LOVIN_" the "F" must represent "G" (which solves all of Line one now also).

In Line two, common sense says "WHEN I SEE YOU GO BY" so I substituted "B" for the "V" (no other word would make sense with a predetermined "Y"-"MY"is the only other choice). Also in line two, "BUTTE__LY, tried "BUTTERFLY" (the one word that just kind of floated to mind (ha, ha!)--it works when I substitute "R" for all "L's", and "F's" for "X's". The final word to be solved in Line 6 is "A_T"; reading the entire story (paragraph) tells me it has to be "ACT". And that's it.

Kids could and probably do use the same type of reasoning to work simple cryptograms--first, start with trial and error and then progress to noticing patterns and using logic to determine if their answers are valid ones (much the same as working mathematical problems!). Most cryptograms I have seen for children provide them with a "set" with which to solve the problem. For example if the title is "Seasons" and you list the four seasons in code, it is easy enough to determine that the two which begin with the same letter are spring and summer and the one with the double letter in the middle is summer. If fall is used, it's a dead give-away (only four letters). Autumn would be harder. If summer had been determined the U's would make autumn easy and thus winter could be determined. (Did you notice that all the seasons are spelled with six letters? Noticing patterns is definitely necessary to solve this cryptogram.)

This type of activity (giving a set) is great for beginners. To make the game a little more of a challenge, you could devise other sets which are broader:

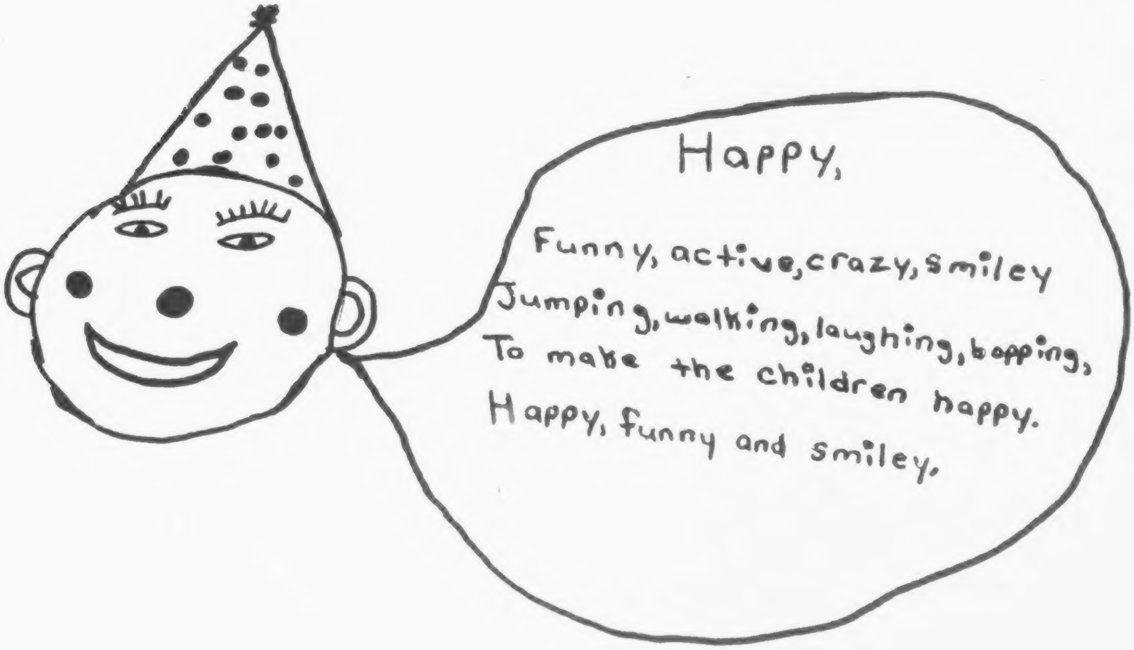
EXAMPLE: "Summer Things"

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

W M B A Z P N R D U T C F V G J E X I Y L Q O K H S (CODE)

IODFFDGN	(swimming)
JDBVDBI	(picnics)
FGIELDYGZI	(mosquitoes)

Progress from lists to paragraphs or stories. These games provide good practice and can be used for secret codes between friends as one way to get kids interested in doing them. This type of "cracking the code" promotes good reasoning skills and encourages "stick-to-it-iveness".


Happy,
Funny, active, crazy, smiley
Jumping, walking, laughing, bopping,
To make the children happy.
Happy, funny and smiley.

By Denise Rouse

BE PREPARED

Helen Miller

The prime objective that I have set for the children in my kindergarten classes is that they learn to think and solve problems by themselves. We have spent much time problem solving and devising alternative methods of accomplishing this. In every phase of the kindergarten curriculum, the children have had to discover and explore by themselves.

What I was not prepared for was the fact that learning to think was not something one turned on and off--on for math and language--off for the in-between times! As a teacher trained as an authoritarian in a dictatorial atmosphere, I have vowed that my classes would be concerned with the whole child who could develop at his own speed and would learn to solve problems for himself. I was not going to teach the children as though they were machines to be fed information and examined to see what information they could feed back when the button was pushed.

At snack time the children determine how many cookies or carrot sticks each one will get. They decide on their own rules for using certain materials. There are times when I wonder if my presence is really necessary.

I am really proud of them and marvel at their competency. But there is a small lump in my throat as I am tempted to fall back into the authoritarian role which once was so comfortable and unchallenged. It is hard to sit back and realize that thinking and problem solving is not meant to be only at math time, but a twenty-four hour a day activity.

NAME STORIES

Lori Buenger

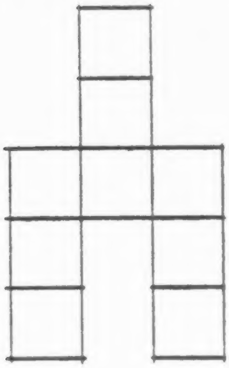
It is said that the most important thing in a person's life is his or her name. Therefore, why not use the children's names to cause them to think, i.e. search for alternatives. Have the child write his or her name and think of a word that begins with each letter in the name so that when completed the words make a sentence or story. Mine is done below as an example.

Lori
Often
Roams
Inward
Because
Underneath
Everything
Now
Grows
Everything
Real

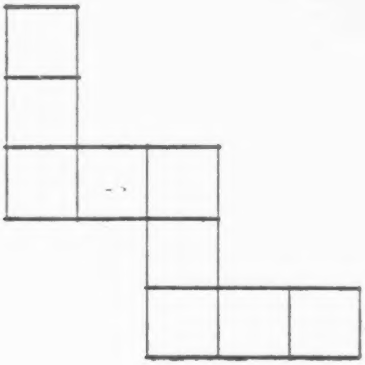
BENDS ON IZZIE'S PROBLEM

Bob Jeffery

Fit the numbers in the squares so that each row and column adds up to the same number. Find all possible solutions.



1 2 3 4 5 6 7 8 9



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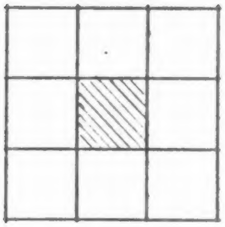
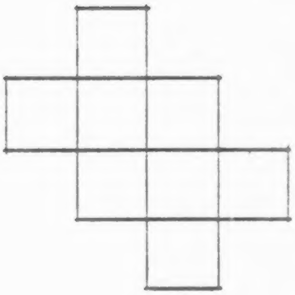


1 2 3 4 5 6 7 8



1 2 3 4 5 6 7 8

CHILDREN'S STORIES

Sharon Harvey

These collaborative stories were written by students at Crispus Attucks Elementary School, East St. Louis, Illinois. They are all students of Sharon Harvey. The stories were written in the following way: A child gave the first word, another child gave the second word and so on.

THE MAGIC PARK

Third Grade Students

Jenny went to the Magic Park, it was creepy. She saw magic trees. The trees were talking and moving. Jenny saw magic people. Jenny saw an old man in the park with nuts in his hands; he held his hand out with the nuts in his hand, and the squirrel ran up to him and got the nuts and ran up the tree.

Jenny saw a magic hat with rabbits jumping in and out. Jenny saw some magic shoes. They were walking to the bench. The magic tree was moving and Jenny tripped over it. Jenny left her books in the tree and sat on the bench, when she went home, she asked her mother could she buy some nuts for the squirrels. The end.

GEORGE THE WRESTLER

Fifth Grade Students

Once upon a time, there was this man, his name was George. He was big and had big muscles. The girls loved him because he was a wrestler. He wrestled a man named Butch. Butch was bigger then George and was twice as heavy as George. He weighed 335 pounds and George weighed 135 pounds. The day had come for the day of the match and George was getting ready. He lifted weights and jogged to keep himself in shape. Suddenly, the moment came for the match, and the announcer announced George and Butch. The bell rung for the fight to begin. The match was over in the first round. Butch was defeated. The end.

RODERICK AND THE DROWNING PUPPY

Sixth Grade Students

The dog was in the rain. He was soaked and wet and very, very cold. He tried to find shelter. He was walking down the street and jumped into a sewer. He fell through the hole. There was water in the sewer. He flopped in the water. He tried to find a way out. Someone heard him barking. Two boys found the dog in the sewer. One of the boys named Roderick jumped into the sewer and was drowning. James heard Roderick screaming for help and jumped into the sewer to save Roderick and the dog. James was a great swimmer.

The End of School

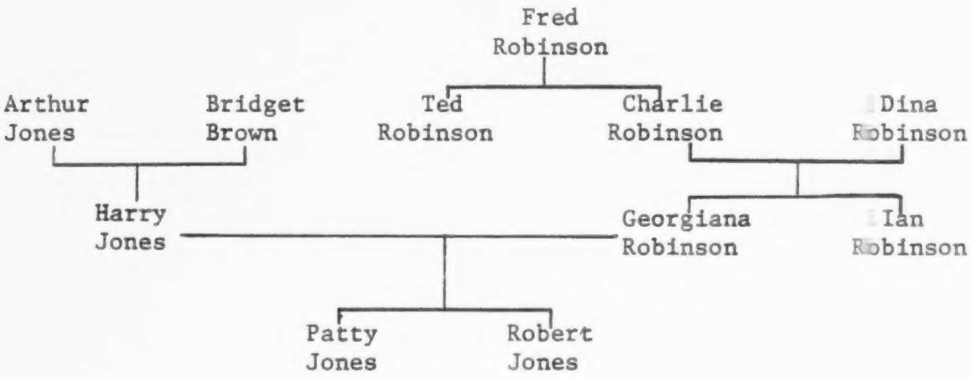
The end of school is near.
I can't wait til it gets here.
When school is out,
You can run about,
Play all day,
Until someone will say;
It's time to go back to
School today.

By Donna
Harwerth

A MATHEMATICAL FAMILY TREE

Janice McDowell

Family relations can be viewed in a mathematical light. Glance for a moment at this ordinary family tree illustrating the result of the union of the Jones and Robinson families.


Fred Robinson
Arthur Jones
Bridget Brown
Ted Robinson
Charlie Robinson
Dina Robinson
Harry Jones
Georgiana Robinson
Ian Robinson
Patty Jones
Robert Jones

Than look at a mathematical version. The capital letters are the initials of the first names.

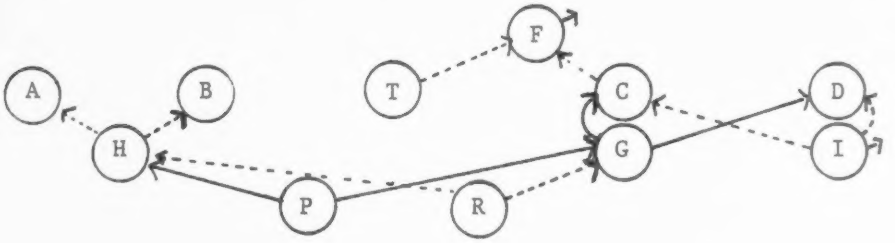

F
A
B
T
C
D
H
G
I
P
R

Figure out the meaning of the arrows in the second tree by comparing it with the first tree. The arrows stand for relationships, not particular individuals.

AUTHOR CRITICAL OF MATH INSTRUCTION

Fred M. Hechinger

A longtime teacher of mathematics defines its purpose as doing efficiently what it would be impossible or very laborious to do without mathematics.

For example, to find the number of seats in an auditorium with rows A to T and each aisle numbered from 1 to 68, without laborious and unreliable process of counting them, you multiply 68 bt 20. This practical, time-saving response to a real situation is likely to make sense to real children.

Compare that application of mathematics to the following examples, taken from elementary school mathematics textbooks:

A. There are five lights. Three lights are off, How many are on?

B. An anthropologist uncovered 17 bones on Monday and three times as many bones on Tuesday. How many bones did he uncover on Tuesday?

C. Mary took $5 to the circus. She spent $3.85. How much money did she have left?

These examples, typical of current math texts and teaching, show what is wrong with much mathematics instruction today. So says Stephen S. Willoughby, director of mathematics education at New York University. He is the author of "Teaching Mathematics: What is Basic?" a booklet published last week by the Council for Basic Education, a nonprofit organization that aims at improving the teaching of basics.

Willoughby's objections to the problems cited are these: Problem A raises the question "Why anybody might want to answer the problem by subtracting," as the authors clearly expect. Any child knows that under real conditions, the thing to do is merely to count the lights. It is a classic example, Willoughby says, of an "unreal" problem that makes a child feel that "mathematics is a way to make work rather than reduce or avoid work."

A youngster begins to think: "If this is mathematics I want nothing more to do with it."

Problem B, Willoughby says, is an attempt to write career education into mathematics--to show how math is used in anthropology. In reality, it does nothing of the kind; it is another way of making mathematics appear useless.

Problem C is equally unreal. No child goes to the circus with $5, spends some of it, adds up what has been spent and subtracts the total from the original amount to find out how much is left. He'd simply count the remaining money.

The very process, says Willoughby, discourages thinking. The word "left" in what is left becomes a code for subtracting. If there are more than two numbers, you add. If there's a small number and a big one, you divide.

Little Wendy, doing her homework, asks her father to show her how to do the first problem on the page. When the father offers instead to solve what looks like the toughest problem on the page, she says impatiently, "Daddy, if I know how to do the first problem, I'll know how to do all of them." Such activities, says Willoughby, may provide practice in performing a single operation, but they do not help students learn to solve problems.

While mathematics begins in the early grades, it does not end there--not even for some otherwise successful young men and women. Earlier this month, the City University of New York convened a three-day conference on remedial college mathematics. Miriam Hecht, who teaches mathematics at Hunter College and organized the conference, seemed overwhelmed when 600 remedial college mathematics teachers--twice as many as had been expected--crowded into the sessions.

"Again and again," Hecht said, "these faculty members compared notes with grim, unbelieving fascination."

Melvin Poage of Central Michigan University said at the conference that one of the flaws in the basic teaching of mathematics is the excessive stress on memory instead of thinking, with the result that pupils forget how to transfer what they have memorized to problems they meet in a different context.

This means that even many students who did well in ninth-grade math need remedial instruction in college.

If students are to become literate in mathematics and science, Poage warned, they must be able to read and comprehend scientific literature. To do so, they must learn to "read mathematics."

Mathematical literacy, said Marilyn Frankenstein of the University of Massachusetts in Boston, "is not the ability to calculate; it is the ability to reason quantitatively." No matter how many computation algorithms they know, students become mathematically literate only when they can use numbers to solve problems, to clarify issues, and to support or refute opinions, she added.

When students spend a great deal of time on drill problems, she said, "they often stop thinking about what they are doing. They will get many correct answers because they get into a 'rote groove,' but they will be stymied by a slightly different problem."

Children, Willoughby says, should learn when a calculator or computer can save time and when it wastes time. But Willoughby also suggests that every high school graduate should have learned at least one computer language.

Early mathematics teaching, he urges, should begin with activities and games--figuring the content of containers of different shape, rolling homemade cubes or dice, with different sets of numbers on each side; understanding decimals and fractions, ratios, and percents; measuring and making scientific notations; collecting and organizing data; and estimating probabilities.

"There are teachers and parents," Willoughby says, "who distrust programs that call for playing games in school. They view school as a place for work, not play, and they think of mathematics as a subject that should be difficult, if not actually unpleasant. If they believe that learning mathematics is a way to develop the soul rather than the mind, they are wrong." The goal is to get people "to think quantitatively and spatially, and if possible to enjoy thinking, so that they will solve problems by thinking even when they are not required to do so in school."

Children, he says, need to be taught the basic facts of the four common operations of arithmetic--addition, subtraction, multiplication and division--and to understand the relationship of those facts to physical objects.

"Students should learn to use mathematical thought to solve problems that are real to them and important to society," Willoughby says. "To do this effectively, they will need to master many subsidiary skills, but such mastery should never by mistaken for the basic goal."

This article, from the New York Times News Service, is printed with the permission of the Belleville News-Democrat, in which it appeared on April 22, 1981.

CHILDREN'S HOUR

Cheryl McAllister

After my junior high literature students have completed a study of plot structure in fiction, I had them write and illustrate children's books. This is an enjoyable experience for them and the project lets me know just how well they understand the workings of plot.

Before the story is written, we examine children's stories from grades one through three. We look for commonalities and characteristics in general. The one characteristic most prefer to use in their stories is the moral.

The book is written on half-sheets of typing paper and illustrations are included on every other page or so. I permit the authors to have an artist friend do the illustrations, if they prefer.

They then design a front and back cover which I laminate. The back cover has a biographical sketch and picture of the author. A dedication page is enclosed and then holes are punched and brass fasteners are used to hold the book together.

Each student is then scheduled to read his book to a group of primary students, so a little work on oral interpretive skills is needed.

The fun they have is obvious when a student returns and beams, "A first grader sat on my lap while I was reading and said he liked my story!" (Editor's note: These books could become a permanent part of the school library.)

SEARCH 'N CIRCLE

Fern Regensberger

4	7	11	9	2	8	10	4	14
9	6	15	8	7	6	13	4	9
13	9	12	3	9	2	7	8	5
2	10	12	5	7	9	11	6	4
11	8	19	3	16	1	18	2	1
5	1	6	10	12	8	4	17	12
6	8	14	4	10	6	4	9	13
6	3	9	2	12	9	3	8	8
12	4	16	8	8	15	10	5	5

Circle ten addition equations. Circle ten subtraction equations. Can you find more?

From: Kids' Stuff Math. Nashville: Incentive Publications. 1974.

Scatterers

Jim Beattie
Madison Middle School
Madison, Illinois

Lori Buenger
Southern Illinois University
Edwardsville, Illinois

Trudy Busen
Southern Illinois University
Edwardsville, Illinois

Linda Cadell
St. Agatha's School
New Athens, Illinois

Shirley Casey
Southern Illinois University
Edwardsville, Illinois

Jan Douglass
Carlyle Grade School
Carlyle, Illinois

Jeanne Edgar
West Junior High School
Belleville, Illinois

Deb Goalby
Red Bud School
Red Bud, Illinois

Colleen Hartry
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Sharon Harvey
Crispus Attucks Elementary School
East St. Louis, Illinois

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The New York Times
New York, New York

Pat Holtgrave
Southern Illinois University
Edwardsville, Illinois

Bob Jeffery
West London Institute of Higher Education
Maria Grey College
Twickenham, Middlesex
England

Sandra Martinson
Douglas School
Belleville, Illinois

Joyce Mathes
Washington School
Belleville, Illinois

Cheryl McAllister
Carlyle Grade School
Carlyle, Illinois

Janice McDowell
McHenry School
East St. Louis, Illinois

Helen Miller
Logan School
Granite City, Illinois

Sue Modro
Henry Raab School
Belleville, Illinois

Mary Beth Peterson
Holy Rosary School
Fairmont City, Illinois

Fern Regensberger
Henry Raab School
Belleville, Illinois

Vicky Schaefer
Signal Hill School
Belleville, Illinois

Vicky Sugent
Southern Illinois University
Edwardsville, Illinois

Sandy Urbeck
Southern Illinois University
Edwardsville, Illinois

Bob Williams
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Scatterers' Helpers

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CARLYLE
EAST ALTON
RED BUD
O'FALLON
GRAFTON
SORENTO
ALTON
HIGHLAND
HILLSBORO
EDWARDSVILLE
BREESE
UNIVERSITY CITY
GODFREY
KEYESPORT
DONNELLSON
MARYVILLE
GRANITE CITY
VANDALIA
HAMEL
EAST ST. LOUIS
SOUTH ROXANA
WITT
FLORISSANT
MULBERRY GROVE
BELLEVILLE
GLEN CARBON
PANAMA
CAHOKIA
GREENVILLE
WOOD RIVER
NOKOMIS
NASHVILLE

SEEDBED

SEEDBED

Number 11

February, 1982

Teachers' Center Project

SIUE

Southern Illinois University
at Edwardsville

INTRODUCTION

We're pleased to bring you SEEDBED 11. It represents the work of teachers from the three existing centers in Belleville, Edwardsville, and East St. Louis, and also from a "might-be new center" in Greenville, Illinois. It's clear from reading these articles that teachers (at least those we meet) are a very gifted, thoughtful, well-read bunch. They are vitally concerned about the quality of thinking that goes on in their classrooms and are willing to take the "extra step" to provide the conditions to keep it alive and growing.

It's especially interesting to see the mini-researches; the replications and extensions of earlier published work that teachers have reported doing with their kids. In this, teachers are rising well above the role of the passive pipeline between textbook publisher and kids, and are assuming the sort of professional role that has them observing the child's thinking (rather than test results) and making appropriate decisions that will support and extend that thinking (rather than focusing only on completing pages in textbooks and workbooks). In sharing their work and their observations, they spark other teachers to read, observe, and make changes in their classrooms. Perhaps this is how real change comes about--from the grassroots level--involving collaboration and mutual support.

Read what's here, try things out, extend them and make them your own. We'd welcome articles from our readers. Just write about the things you've been reading, thinking about and doing. But first, join us in the view that knowledge is not a spectator sport.

T. C. O'Brien

Thomas C. O'Brien

Shirley A. Casey

Shirley A. Casey

Edwardsville, Illinois
February 15, 1982

* * * * * * * * * *

ABOUT THE COVER

The cover of SEEDBED 11 bears the names of communities whose teachers took part in Fall 1981 sessions of the Teachers' Center Project. As you see it covers a broad area! Many towns, many teachers and even more kids are getting involved in the business of thinking and problem solving. And if one listed the countries that Seedbed reaches, it would become evident that a real network of collaboration and mutual support exists on behalf of kids. Hooray!

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☐ Please send me the next 4 issues of SEEDBED as they become available. I enclose $10.00

Name ______________________________

Address ______________________________

City ______________ State __________ Zip ________

Date ______________

Mail to:

Teachers' Center Project
Box 122
Southern Illinois University
Edwardsville, IL 62026

****

We are pleased to announce a special Teachers' Center Project publication, "Toward the Twenty-First Century in Mathematics Education." In December 1981 a number of math educators -- Tamas Varga (Budapest), Jim MacLean (Toronto), Izzie Weinzweig (Chicago), and others -- got together at SIUE to produce a series of essays ranging from mathematics content to assessment to the role of the computer in American life. Copies are available at $2.50.

A COPY OF REALITY?

Cindy Blumberg

At the Teachers' Center we had discussed that knowledge is a construct of reality, not a copy of it and evidence that children don't function like xerox machines--they don't store exact copies of reality. I felt certain that every child in my class had seen orange juice in a bottle and had seen that bottle tipped for pouring, etc.

So I made a ditto showing six identical bottles in five different positions. I gave each child a copy and then asked them to imagine what the orange juice would look like in the bottles. I also drew the bottles on the chalkboard and asked one student to "put the orange juice" in Bottle 1. The children copied what he did on their papers. Then I asked them to draw the orange juice the way it would look in each of the other positions. I deliberately made Bottle 6 identical to Bottle 1 to see what would happen.

The children's responses appear throughout Seedbed 11. Take a careful look and think about what you see. Given that much of what children report could not possibly exist in our world, can we continue to pretend that the mind is a camera?

The following two references deal with this topic:

Brearley, Molly (ed.). The Teaching of Young Children. New York: Schocken Books, 1969, pp. 90-91.

Tamburrini, Joan. "Implications of Piagetian Research for Education." In Proceedings of the First American Conference on Teachers' Centers. Teachers' Center Project of Southern Illinois University, Edwardsville, IL 62026 p. 62.

I LIKE IT BETTER WHEN I LEARN SOMETHING TOO!

Mary Steffen

Much of the difficulty 10-12 year olds experience in math could be avoided. But since we live and teach in a context where problems occur, we must explore ways to repair difficulties as they appear. Many such difficulties have their roots in the child's understanding the basic structure of mathematics. One such difficulty is that of knowing and being facile with the reversibility of operations.

PROFILE OF AN 8-10 YEAR OLD MATH STUDENT:

Bewildered when choosing an operation to use on word problems. Cannot move from one operation to another in long division and/or multiplication. Borrowing or regrouping in subtraction is difficult. Incorrect answers are just as sensible as correct ones.

I share here several approaches which may facilitate learning for both the student and the teacher.

I. Explore the student's mathematics with questions such as: 'When you add do the numbers get bigger or smaller?" "When you subtract, do the answers get bigger or smaller?" (Many students will not find this easy.)

Move bravely on to: "Do numbers get bigger or smaller when you divide? Multiply?" It takes real courage to continue with: "To get bigger the quickest, would you use times or do you add?" "To get smaller the quickest would you subtract or divide?"

A lovely investigation could come of these questions. A group of students might wish to explore, keep records and present their findings.

II. Another approach to try:

Give the student a set of cards such as the following:

$\boxed{3}$ $\boxed{4}$ $\boxed{X}$ $\boxed{\div}$ $\boxed{12}$ $\boxed{=}$

or more simply

$\boxed{3}$ $\boxed{4}$ $\boxed{+}$ $\boxed{-}$ $\boxed{=}$ $\boxed{7}$

Ask the student to make four problems using only the set of cards given. Refuse to help. You, like I, will be surprised at how much learning can take place while the teacher pursues childwatching and the student pursues constructing mathematics for himself.

III. Another possible experience comes from SEEDBED #9,

MAGIC NUMBER

Joyce Mathes

This game is played with a deck of cards, with all the picture cards removed from it. You may use several decks of cards, depending upon the number of students playing. It is not necessary to have complete decks—a good use for all those "useless" cards laying around.

Shuffle the deck and turn the first card face up. This card becomes our "magic number".

Deal four cards to each player. The remaining cards are dealt into stacks of four cards each, to be used later.

The player must add, subtract, multiply or divide (or any combination) all four numbers on the cards in his/her hand to arrive at the "magic number".

For example, if our "magic number" was 2 and we were dealt a 4-1-5-3, we could add 5 + 4 = 9; divide by 3, 9 ÷ 3 = 3; and subtract 1; 3 - 1 = 2. Note that each card has been used only once.

If we were dealt a 10-7-3-8, we could add 8 + 7 = 15; subtract 10, 15 - 10 = 5; and subtract 3, 5 - 3 = 2.

Other examples: 10-6-7-2 (10 = 6) - (7 X 2)
10-4-10-2 [(10 - 10)(4)] + 2

After the player has found the "magic number", (s)he is to write the solution down in case it is necessary to verify it later. (S)He then gets another stack of cards from the pile.

After the draw pile has been depleted, we then list on the board the numbers of the cards and the students' names who have not found the "magic number". The first player to find the "magic number" may then take the cards from that player. The player with the most cards wins.

I have limited the children to using whole numbers only. Any division must result in a whole number.

IV. Using Thomas C. O'Brien's "Grid Puzzles" (Cuisenaire Co. of America, 1980) is yet another approach. Here I allow myself the luxury of detailing one example of the student profiled above.

KC had been through all the easier, shorter, simpler activities already cited. He had progressed, but not enough to prevent daily stumbling over issues which required reversibility of operations. "HELP!" I said to my head. And it responded with an image of a bright student stumbling over the reversibility issue while using Tom's Number puzzles. And a second image of a bright adult having pause over the same issue in Tom's Apple program of the same grid puzzles. Both had immediately reconstructed their mathematics while I watched. I could use the Number Puzzle with KC! It had enough practice that KC just might be able to reconstruct his mathematics, too, but more slowly. Here is what happened.

The book starts slowly with grids for addition facts, then subtraction facts.

+	3	4
5	○	○
8	○	○

−	4	7
11	○	○
15	○	○

KC took several days to get used to the grid arrangement.

Next some of the "answers" are given and the problems are missing.

+	5	6
○	○	11
○	○	15

−	○	○
○	3	7
16	○	8

KC spent nearly two weeks struggling with reversing the operations + and −. Steadily his speed increased. More and more he used his fingers to count, leaving his brain free to do the important part, thinking reversibly. His confidence grew.

Then came the same issue presented in multiplication and division. His struggle was shortened from two weeks to two days. "Your head is working better these days, huh?" I queried. "Yep," he grinned.

The final issue involved using a rule instead of an operation, with blanks left where the answers usually go.

(L×T)+2	7	10
4	30	○
5	○	○

Then blanks left where the numbers usually go.

(L+2)+T	○	○
7	15	14
12	○	○

Then the rule left out.

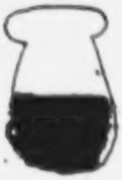
○	7	8
10	60	70
12	72	84

The successful accomplishment here meant not only reversing operations several times, but also in a certain sequence. I was certain he couldn't manage and cautioned him so as not to crush his new found confidence if the issue proved too difficult. Never underestimate the brain's ability to construct mathematics for itself! KC successfully navigated this last, most difficult task, and is now sailing happily through word problems.

I hope you will find at least one of my approaches useful with some of your students. But more important is making these approaches you own, "bend them," and then share your own discoveries.

* * * * * * * * * *

1.



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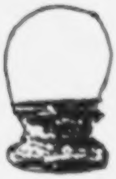

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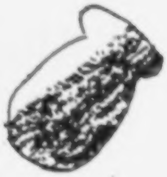

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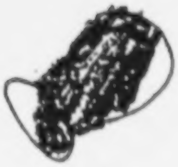

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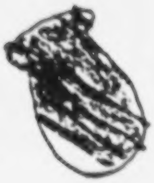

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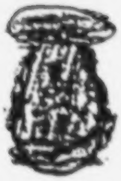
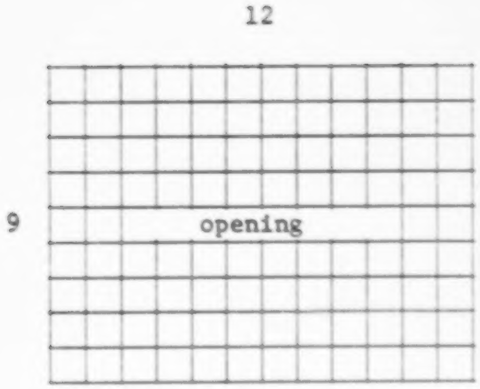


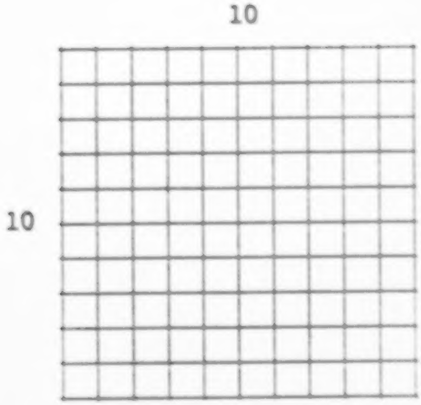
MAKE A SQUARE

Jim Beattie


12
9
opening

Separate into two pieces

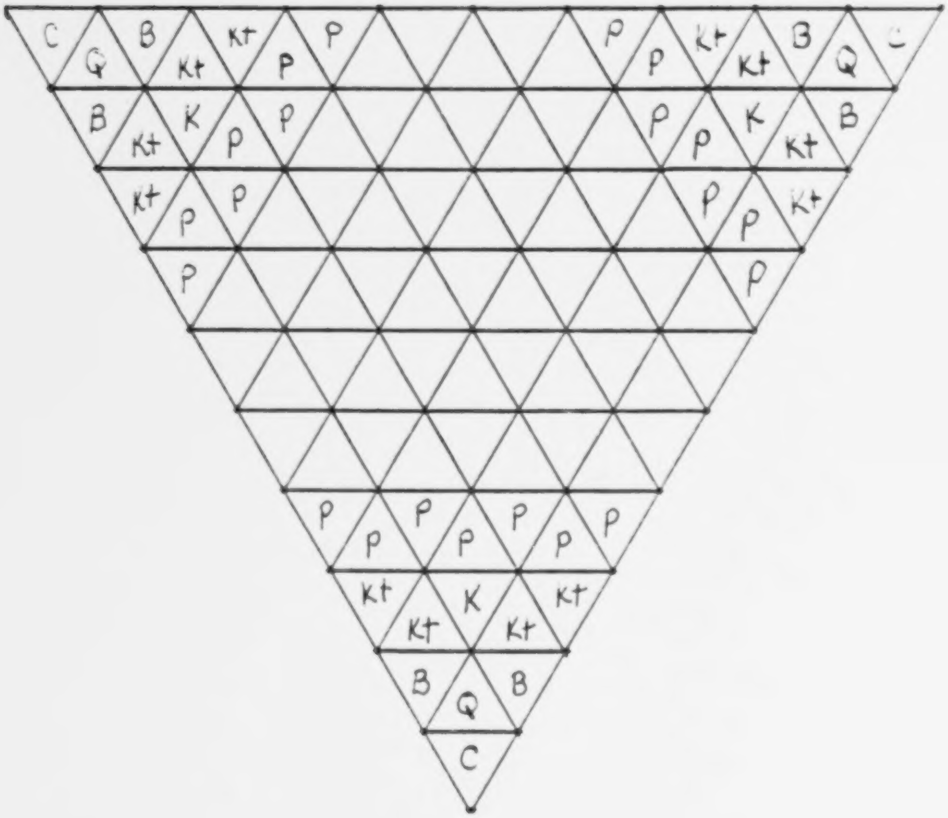
then put together to make this square.



Turn to page 125 for the answer.

DELTACHESS

Jeanne Edgar


C
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B
C

This game is like chess but the board is a triangle instead of a square. The original board is set up as shown above. The Bishops, the Knights and the King should move by crossing at vertices, while the Castle and the Queen should move by crossing sides. The Pawns should use sides for normal moves and vertices for "taking".

The Castle is now a semi-static piece moving only if attacked. It is against the Castle that the operations "check" and "checkmate" are to be directed. This leaves the King free to lead his Knights into battle while the Queen stays at home with the Bishops.

Here are the details of the permitted moves.

Castle: move one triangle at a time across a side.

Queen: move any number of triangles in a straight line (until blocked by another piece) crossing sides only.

Bishops: move any number of triangles in a straight line, crossing at vertices only. (In certain circumstances this may result in "no move".)

Knights: move across two consecutive intersections in any direction; may jump over other pieces if necessary.

King: move one triangle at a time across a vertex.

Pawns: move by crossing sides from one triangle to the next; initially a double move by crossing sides; but crossing at a vertex when taking.

Two or three players can play. If three are playing then a third set of chess pieces of a different color are needed. Red would be a good color if making your own game.

If a player should lose his King then he must withdraw from the game all his pieces removed from the board.

Note. This game came from J. E. Brider's "Further Adventures" which appeared in the Spring 1967 issue of Mathematics Teaching.

SOME SUBTRACTIONS

Joyce Goodall and Susan Modro

In Mathematics Teaching (June 1978) Alistair McIntosh published "Some Subtractions: What Do You Think You Are Doing?" I decided to try this with my students.

Teachers gave the following five subtraction problems to the children and asked them to solve them and then to supply a story problem for one.

Q1 8 - 3 =
Q2 27 - 18 =
Q3 72 - 29 =
Q4 431 - 145 =
Q5 10,000 - 1 =

The purpose of the investigation was to get an idea of the responses at various ages and to compare them with the expectations of the teachers.

The table below shows the percentage of children in each age group who answered the questions correctly. Most of the teachers in the survey overestimated the capabilities of the children. Many teachers considered the horizontal layout of the questions to be a factor in why the scores were so depressed.

Percentage of Correct Responses

Age	7	8	9	10	11
Q1	86	98	98	98	100
Q2	41	69	79	85	90
Q3	9	20	37	54	66
Q4	0	7	16	35	41
Q5	3	5	13	17	38
Actual Number	76	129	132	161	73

Below are charts indicating how local students scored on the questions.

Percent of children in each age group who answered correctly

Age	9	10	11	12
Q1	100	100	100	100
Q2	57	90	94	100
Q3	43	50	88	96
Q4	33	50	76	57
Q5	24	60	88	100
Number of Students	21	20	17	7

Joyce Goodall's Students

Percent of children in each age group who answered correctly

	Age	10	11
Q1	8-3	100	100
Q2	27-18	75	94
Q3	72-29	81	100
Q4	431-145	69	67
Q5	10,000-1	50	72
Actual Number of Children Involved		16	18

Susan Modro's Students

Children in our classes were asked to make up a story or situation which would give rise to question 3 (72 - 29 =). According to the article, children often get abstract calculations right without knowing when these calculations could be used.

We found our results to be quite similar to McIntosh's results. Some of the story problems are inventive, some are bizarre, and some appear almost totally irrelevant. Here are some of the responses. (All of the children had performed the computation correctly.) The age of the respondent from Ms. Goodall's classes is indicated in parentheses.

From Joyce Goodall's Students

Mike had 72¢, then he found 29¢. That made $1.01. Then he lost 58¢. How much money does he have now? (12)

Team A has 72 points. Team B has 29 points. How many points ahead is Team A? (12)

Jane has 72¢ and she wanted to buy Tootsie Rolls for 29¢. How much would she have left? (?)

There were 72 raffle tickets sold. 29 of them belong to the fourth grade. How many did the fifth grade sell? (12)

Joe got $72 for mowing 10 lawns. He spent $29 on a race car track. How much did he have left? (11)

72 species of birds were at a wildlife preserve. 29 species became extinct. How many species are left? (11)

In Miss Goodall's classroom there are 29 people. She said they had to bring 200 soup labels. They came to school with 72 short. How many did they bring? (11)

You have 101 apples and one hour later you eat ten and two hours later you lose 19. How many are left? (11)

There are 29 planes at Lambert and 72 at Scott Air Force. How many come from Lambert? (11)

There are 43 marbles and you have only 15. How many more marbles do you need? (11)

Sue had 29 apples. She needs 72 apples. In order to get 72 apples she has to buy them or somebody has to give them to her. How much would she have to spend? (11)

43 + 29 is 72 so 72 take away 43 is 29. (12)

There were 72 alligators in a woody swamp but 29 alligators left this summer. How many alligators are left? (9)

Yesterday, I bought a hat, nailpolish, shirt, pants, hamburger. The hat was $5.00. The nailpolish was $2.50. The shirt was $17.00. The pants were $25.00. The hamburger was $1.25. How much in all? (10)

Cathy went to the grocery store. She went looking through the candy isle. She decided that she wanted malted milk balls that cost 72¢ including tax. Then Cathy took the milk balls to the checkout counter and gave the cashier a coupon worth 29¢. The cashier rang up 46¢ and Cathy paid it. What should Cathy have paid? (11)

One summer day Julie ran into the house and said, "Mommy, Mommy, look what I won!" She had 72 boxes of gum. She said, "What am I going to do with all this gum?" Then her mother said why don't you give some of it to the kids at school, and Julie said, "O.K." So she gave away 29 boxes of gum and still had 43 left. Her mother said that she could keep it, but only if she chewed one piece at a time.

From Susan Modro's Students

Children were asked to make up a story situation which would give rise to question 2. All of these children had previously calculated the answer correctly. When it came to devising word problems, some were correct, some bizarre and some appear totally irrelevant; some show misunderstandings.

Q2: (27-18 = 9)

There was once a rabbit who had 27 carrots and he had 18 lettuce heads. How many does he have left? 9 left.

An automobile dealer bought 96 tires. How many sets of 4 tires did he buy?

Danny had $27.00. He bought a football and it cost $2.00. Then he bought a bike that cost $10.00. Then he bought a car and it cost $15.00. How much did he have left? 0

A DC-10 flew 27 miles. It had to go back 18 miles. How many miles did it fly all together?

There were 27 kittens. Lost 18 of them. How many more to find?

Jimmy has a ranch and he has 27 horses. If 18 of the horses jump the fence, how many are left?

Sandy had 27 pieces of candy. She ate 18. She now has 9 pieces left. The next week she went to the dentist and she had 9 cavities too. MORAL: Be careful

Don't eat a lot of candy.

* * * * * * * * * *

CAN YOU MAKE A HUNDRED USING THE DIGITS 1-9?

Eva Weldon

Rules:

1. You must use all nine digits.
2. You may not change the order of the digits.
3. You may use operation sign: +, -, X, ÷
4. You may put digits together such as 12 X 3 or 1 X 23 + 4 or 12 + (3 + 4) - 5, etc.

There are many possible ways to "Make a Hundred."

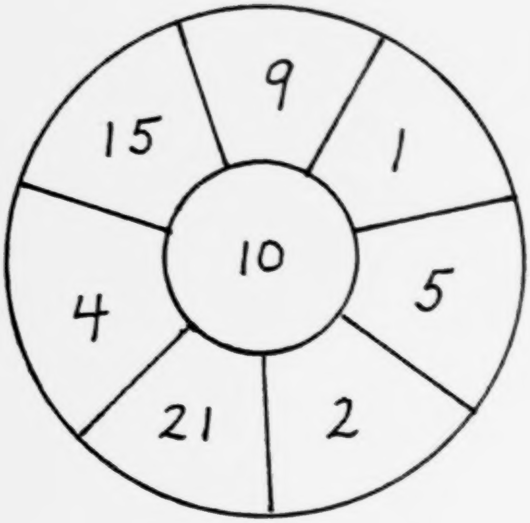
Here's one:

$1 + 2 + 3 + 4 + 5 + 6 + 7 + (8 \times 9) = 100$

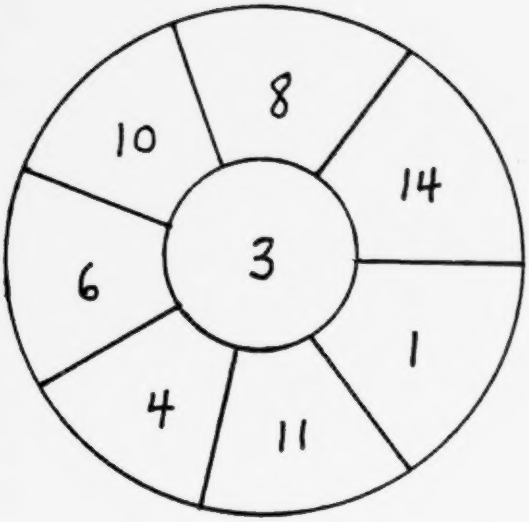
How many others can you find?

NUMBER DARTS

Barb Zarzeck



Jeff threw 4 darts at the dart board. He scored 25 points. Each dart hit a different number. What numbers could he hit to score 25 points? What are other possibilities?



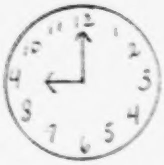
Lindsey threw 4 darts at the dart board. She scored 35 points. Each dart hit a different number. What numbers could she hit to score 35 points? What are other possibilities?

Note. What kind of dartboard is needed if you use four darts and you'd like to be able to score every number from 10-25?

IT MUST BE TIME TO GO!

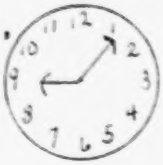
Helen L. Miller

The day is long,
And I've been gone
----- from home!



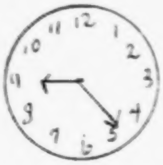
It must be time to go!

"One hour," the teacher said,
Since we got out of bed
----- at home!



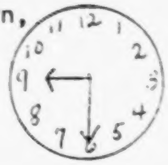
It must be time to go!

Mike brought some snacks,
In a big brown sack
----- from home!



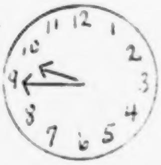
It must be time to go!

The teacher said it's my turn,
But most of all I yearn
----- to be back home!



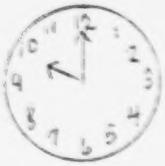
It must be time to go!

Larry said he'd be my friend,
And gave me a toy that bends
----- to take home!



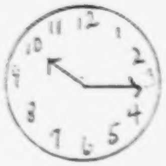
It must be time to go!

That table has some funny things,
I wish I had some wings
----- to fly straight home!



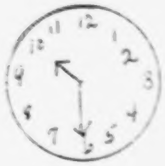
It must be time to go!

"May I play there?"
"Would you like to share?"
----- our toys?



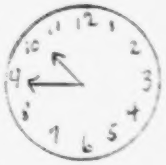
It must be time to go!

Teacher has a smile.
Maybe she'll read a story after while
----- at school.

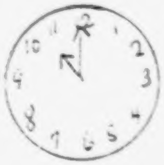


It must be time to go!

Blue and yellow make green.
That's the funniest thing I've ever seen
----- in the whole, wide world!



It must be time to go!



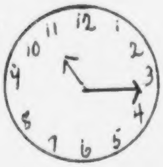
It is my turn to find out how much I weight,
But teacher said, "Another day."
----- at school!

I hope it's not time to go!

"Mommy, see what we did,

Me and another kid"

----- at school!



Do I have to go?

* * * * * * * * * *

INTERESTING PATTERNS

Jeanne Edgar

1 × 9 = 9
2 × 9 = 18
3 × 9 = 27
4 × 9 = 36
5 × 9 = 45
6 × 9 = 54
7 × 9 = 63
8 × 9 = 72
9 × 9 = 81

1 × 99 = 99
2 × 99 = 198
3 × 99 = 297
4 × 99 = 396
5 × 99 = 495
6 × 99 = 594
7 × 99 = 693
8 × 99 = 792
9 × 99 = 891

1 × 999 = 999
2 × 999 = 1998
3 × 999 = 2997
4 × 999 = 3996
5 × 999 = 4995
6 × 999 = 5994
7 × 999 = 6993
8 × 999 = 7992
9 × 999 = 8991

1 × 9999 = 9999
$2 \times 9999 = 1\underline{999}8$
$3 \times 9999 = 2\underline{999}7$
$4 \times 9999 = 3\underline{999}6$
5 × 9999 = 49995
6 × 9999 = 59994
7 × 9999 = 69993
8 × 9999 = 79992
9 × 9999 = 89991

Notice, the 999 remains in the center of the answer between 1 and 8, 2 and 7, 3 and 6, etc. There is always one less 9 in the answer than in the factor.

Can you predict the answer for 2 × 99999? How about 7 × 9999999?

FRIENDLY FRIENDS FROM OTHER PLANETS

Jean Speiser

Creatures made of small yarn pompons were used in a classification activity. Each of the characters was slightly different from the others--different colors, ears, tails, noses, eyes, tails, etc.

I divided the creatures into groups and asked the children to tell me the rule I'd used for classifying them and to give each group a name. Later a small number of children regrouped the creatures for the others to name and tell the classification rule.

The creatures lend themselves to many groupings.

Some of the categories my students devised were

Koogle-Boogles = 4 Tails
Nett-Metties = 2 Tails
Foop-Toops = 2 Colors
Noon-Moons = No Nose
Teek-Neeks = No Tails
Mool-Fools = 2 Eyes and a Mouth

After this I gave the children the worksheets which follow. The children worked in groups to solve the problems.

Note: Wollygoggles and Other Creatures by T. C. O'Brien (Cusenaire Company of America, 1980) provides many other problems of this kind.

These are Curly-Loops!

1,461 264 31,869 764

These are not Curly-Loops!

32,792 8,151 6 531 6,656

Which of these are Curly-Loops? Put the answer on the line. Use the letter below the problem.

1.	8,916 A	765 B	Both C	Neither D	________
2.	74,169 E	5,260 F	Both G	Neither H	________
3.	9,144 I	715 J	Both K	Neither L	________
4.	26 M	63 N	Both O	Neither P	________

These are Moodkoos!

8 4 6 6 9 3

These are not Moodkoos!

4 9 7 7 2 9

Which of these are Moodkoos? Put an "X" on the correct answer.

1.	5 7	2 10	Both	Neither
2.	1 9	8 8	Both	Neither
3.	4 8	0 12	Both	Neither
4.	7 6	11 1	Both	Neither

ANSWERS:

1. B Curly-Loops have a 6 in ten's place value.
2. G
3. L
4. N

ANSWERS:

1. Both Moodkoos have a sum of twelve.
2. Neither
3. Both
4. 11 1

BEHAVIOR MODIFICATION IN THE ELEMENTARY SCHOOL--A CRUDE FORM OF MOTIVATION

Jeanne B. Montaldo

Behavior modification is one of the important methods of psychotherapy. The method deals primarily with overt behavior, uses principles of conditioning, and concerns itself with the present as opposed to probing the past (as in psychoanalysis). The practitioner of behavior modification believes that poor behavior was learned and so (s)he attempts to reteach appropriate responses by reinforcing new and desirable responses and eliminating reinforcement for poor responses.

It is important to define behavior modification in its true form in order to compare it with the casual definitions that obtain in classrooms for behaviorally disordered children in elementary schools.

Before we begin to see the grade school uses of behavior modification, let us be reminded that teachers who are certified for B.D., L.D., and E.M.R. are not licensed psychiatrists or psychologists, yet they are using a method of psychotherapy which has proven powerful enough to encourage a schizophrenic mute to talk after a 19 year silence by reinforcing his desirable behavior with chewing gum.

Behavior modification is a treatment which is phased out after it is successful. It is a safe assumption that once begun, it is not continued by psychiatrists or psychologists day in and day out, year after year, on a single patient unless some good effects are obvious. Yet schools use behavior modification day in and day out, year upon year, with the same child.

Studies of such behavior reward systems have shown that reward systems should not be used for behaviors which could possibly occur naturally. (B.D. classroom children often receive or lose points for staying in their seat. Staying in one's seat obviously does occur on its own, therefore staying in one's seat does not qualify as a behavior modification objective.) Furthermore studies have shown that unnecessary rewards may, in the long run, decrease the frequency of behavior that one is trying to increase. The desired behavior may occur only when the reward is given.

But one need not consult modern psychology for these observations. John Locke observed the following more than three centuries ago. "Let therefore your Rules to your son be as few as possible, and rather fewer than more than seem absolutely necessary. For if you burden him with many Rules, one of these two Things must necessarily follow; that either he must be very often punish'd, which will be of ill Consequence, by making Punishment too frequent and familiar; or else you must let the Transgressions of some of your Rules go unpunished whereby they will of course grow contemptible, and your Authority become cheap to him."

I will share with you some of the things that I have seen so that we can wonder together.

I have seen children in elementary school who are behaviorally disordered screaming and sobbing hysterically outside a classroom because they had not earned the reward that week, a 30 minute popcorn party. Other teachers were not to speak to or console the children. One anguished child continued for a very long time, perhaps ten minutes. This scene was repeated every Friday afternoon.

I have watched a teacher spend large amounts of classroom time adding up chart points while a restless B.D. class gets into trouble and loses more points.

Once on the playground a B.D. teacher carrying "the chart" had her pencil poised during the entire play period. The poised pencil was the "control" device used to keep the students in line. (They still fought each other.) A young boy in her class asked if she would catch the ball. She was young, able, and dressed properly for play. The young teacher said, "No," then confided to me, "I'd like to catch it but I'm too busy with this chart!"

Once a fourteen year old boy had a good reason to move to another seat to copy off the board. The teacher was busy with another child and told him to stay in his seat. As she picked up the chart, he said, "I'm sitting over here so that I can get away from over there. Go ahead and write, I don't care." This boy did not get a rice krispies treat. In this class 75 points earned free time and 79 points earned free time and a rice krispy treat. He only received free time. Three boys out of seven got treats.

Often one child gets another into trouble. It is not hard for a teacher to have missed a sly action and remove points from the wrong boy. "Don't write nothin' down about me, Miss X!" Miss X wrote sternly as he tried to talk to her. A great deal of time is spent over "justice." What do children learn about justice in such situations?

My impression is that the teacher is looking for short term results. If the rice krispy treat is an insignificant reward (i.e., does not alter behavior) then there is no point in using it. It merely creates hurt feelings. It amounts to rudeness--feeding some and not others. (If it is indeed a significant reward, then its results must be measured and taken seriously. It must be proved effective or be discontinued.) My observations say that it is clearly ineffective and yet it is continued.

Let's assume for a moment that the chart and treat system were actually working. Is it what we really want? From the teacher's point of view there would be short term success. Her supervisor would praise her for a quiet and orderly classroom. "Miss X is the only one who can handle them. She is doing a great job!" Is she? What has really happened to the child? The child has learned the rules of the game for that teacher and nothing more. The child has given in (or given up). But the children either cannot or will not apply the rules to situations outside the classroom or even within the classroom if that teacher is away. The teacher has at the most brought children to submission. Submission of one human being to another, of course, raises moral questions in any modern society.

Let us not as certified teachers and professionals risk doing a poor job of psychotherapy which could actually hurt children. Let us instead leave psychotherapy for the psychotherapists. Let us work to excel as professionals in our field as teachers, those who promote a love for learning with love and kind example.

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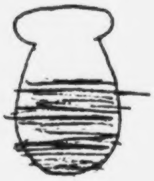

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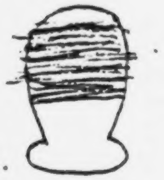

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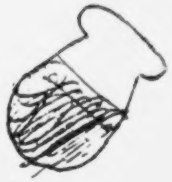

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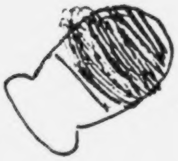

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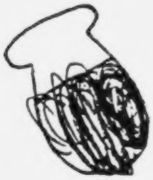

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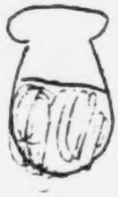
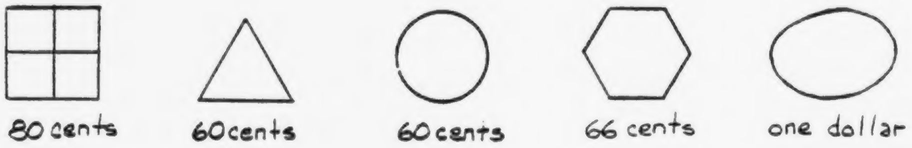


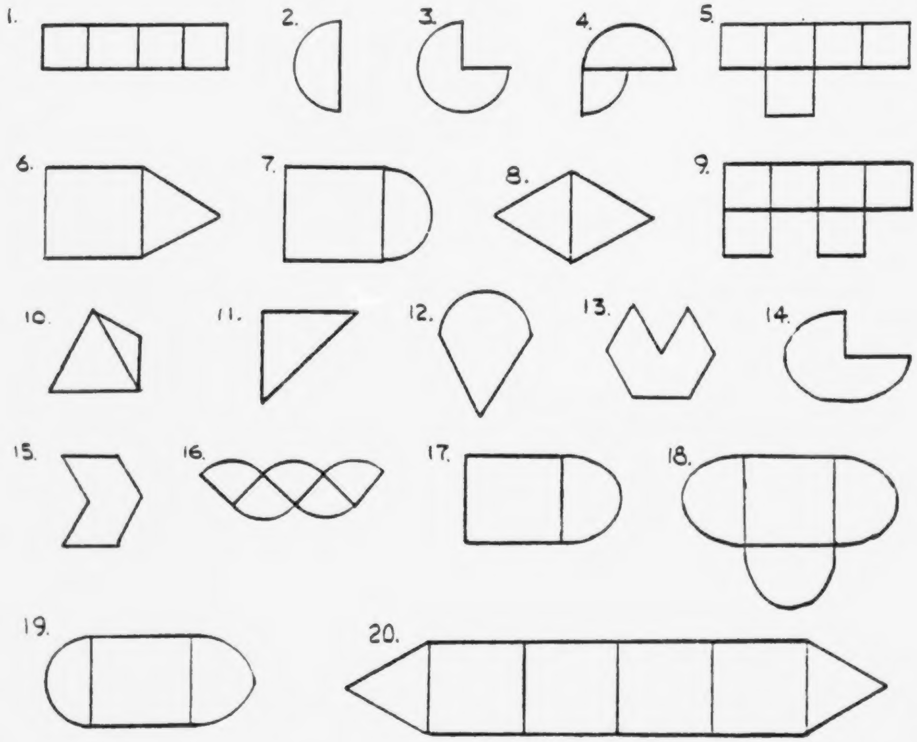
HOW MUCH DOES EACH PIE COST?

Joan Waggoner

Pies were baked in many different shapes and sold at different prices.

How much would you pay for pies shaped like those below?


80 cents
60cents
60 cents
66 cents
one dollar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This activity was inspired by the Fall 1981 Teacher's Center Session. I was especially encouraged by reading the David Fielker transcript.

Many activities lik[illegible] promoted by the late Ernest R. Ranucci, Professor of Math Educ[illegible], SUNY at Albany.

PRAISE IN THE CLASSROOM

Julia Hodges

I had never given much thought to the possibility that praise could be doing just the opposite of what we intended until I read David Martin's article, "Your Praise Can Smother Learning." Doling out jellybeans has never met with my approval but I have certainly used such comments as "Steve, that is excellent," or "Mary, I'm so proud of your work." Martin points out through research that praise gets in the way of learning. Students receiving high praise have less confidence in their ability. They learn to work more for praise, to please the teacher, and less to satisfy themselves, through inquiry.

If praise does seem to be a main problem in the classroom and thus you are a behind-the-scenes manager of children's behavior rather than a helper of children's growth, learn to slow down. Be silent more often. Let the students learn to set their own goals and determine their own strategies. Private conversation will do more to build confidence than open praise in the classroom.

I find Martin's last paragraph amusing but quite truthful. He states: "If you manage to stop praising students and then find that the urge to praise is building up inside you and that you absolutely must relieve the pressure by praising someone, lay it on your colleagues. Overt, heavy, person-oriented praise has not yet been found to have deleterious effects on teachers."

BUREAU OF MISSING NUMBERS

Barbara Grigg

Be detectives and investigate some missing numbers. These are the following descriptions:

1. Attention all detectives. We have a missing number. He is even. He has an older sister who is four. Can you identify him?

2. Attention detectives. A number is missing. It was last seen around the middle of the number line. It has five tens, is odd, and is smaller than 53. Who is it?

3. All cars be on the lookout for a missing number. His hundred's place is an even number between 6 and 9. His ten's place is 7. His one's place is an odd number less than three. Who is he?

4. Officers attention. Pick up a blue car doing twenty miles over the speed limit in front of the school. How fast is he going?

5. Robbery at the bank! Attention all squads. The robber got two hundred dollars bills, one twenty, two tens, and a five. How much did he get?

6. Make up some of your own!

MAGIC SQUARES

Susan J. Modro

I presented the "Magic Squares" activity to my fifth grade math class.

They were instructed to make nine one-inch squares and to put the numbers 1-9 on them. They placed the numbered squares on a 3 x 3 grid so that the numbers added up to 15 in all rows (⟷), all columns (↕) and both diagonals (⤢ and ⤡).

Two students were quickly able to come up with solutions. Several children continued to work on their magic squares throughout the week.

At the end of the week, we took all the solutions (eliminated the duplicates) and recorded them. Seven solutions were determined.

6	1	8
7	5	3
2	9	4

8	1	6
3	5	7
4	9	2

6	7	2
1	5	9
8	3	4

2	7	6
9	5	1
4	3	8

8	3	4
1	5	9
6	7	2

4	3	8
9	5	1
2	7	6

4	9	2
3	5	7
8	1	6

I put the solutions on a ditto and asked the children to write down any patterns they could find. (They worked in small groups.) These are the patterns the children determined:

- 5 is always in the center square
- 8-1-6 are always together
- 3-5-7 are always together
- 2-9-4 are always together
- 1,5,9 are always together
- 8-3-4 are always together
- 2-7-6 are always together
- 2,4,6,8 (even numbers) are always in the corners and the odd numbers fall in between
- 2,5,8 are always diagonal
- 6,5,4 are always diagonal

ACTIVITIES AND BENDS

Peggy Read

BENDS ON "BUILDING UP"

In his article entitled "Toward a Feeling for Numbers" in the August 1980 Seedbed, Bob Jeffery presented a game which he called "Building Up". To play, each child must have a place value chart with places for tens and ones and a number of chips, counters or similar objects. In turn, each player rolls a die and places on his chart the number of chips indicated by the roll. As he accumulates ten chips in the ones place, he exchanges them for one in the tens place. The object is to be first to accumulate a specified number value.

Two problems developed when my second graders tried to play this game. First, the children were reluctant to give up ten chips in exchange for just one. The fact that this one represented ten on the chart was just too abstract to be acceptable.

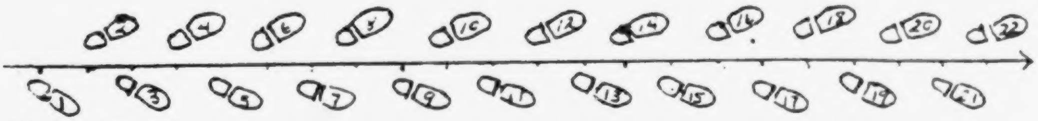
Secondly, even though we had done extensive work with two digit numbers, the children could not look at their chips and tell what number they represented. More often than not two in the tens place and three in the units place was read as two and three or as five rather than as twenty-three.

The game was abandoned until slight revision of the rules made it all come clear. Instead of chips, we played the game using the ones and tens units from our cuisenaire rods, and changed the name of the game to "Trade Off". Now, when the die is rolled, the indicated number of ones is taken and placed on the chart. As ten ones are accumulated, they are "traded" for a ten rod. This trade seems much more logical to the children and the final accumulation of ten rods and single units is readable because they have had experience in reading these collections before.

To extend the game even further, one may play in any base using the given denomination of rod. For example, base four numbers may be built using single units and four rods, trading in four units for each rod.

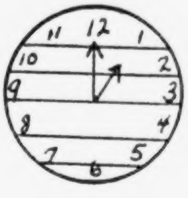
WALKING THE NUMBER LINE

Number lines are helpful devices in many ways for young children and for primary age kids who really need to get "involved" in their math walking the number line may be just the thing. Draw the line on the floor. Space the points a short footstep apart and use paper cutouts of footprints to write the numbers on. Children soon disdover that as they walk away from one they are adding. As they walk toward one they subtract.



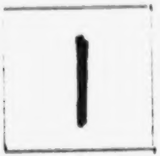
CLOCK RELATIONS

In looking for number relationships, don't forget the clock. Divided by parallel lines, the face provides combinations of 12. Does every circle with evenly spaced numbers provide similar pairs? Try it!



EGYPTIAN NUMERALS

While working with other numeration systems and place value, why not try the Egyptian numerals? Place them on 4" x 4" cards and let the children work in pairs creating and reading numbers or adding and subtracting in the system.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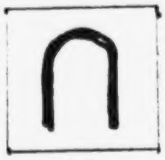
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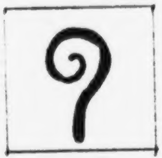
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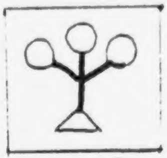
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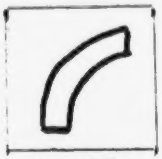
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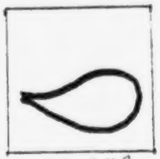
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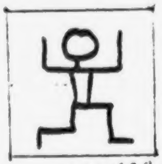
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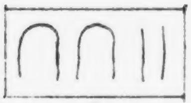
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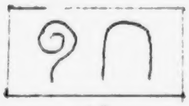
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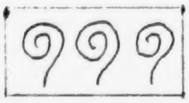
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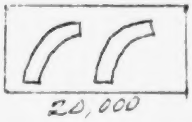
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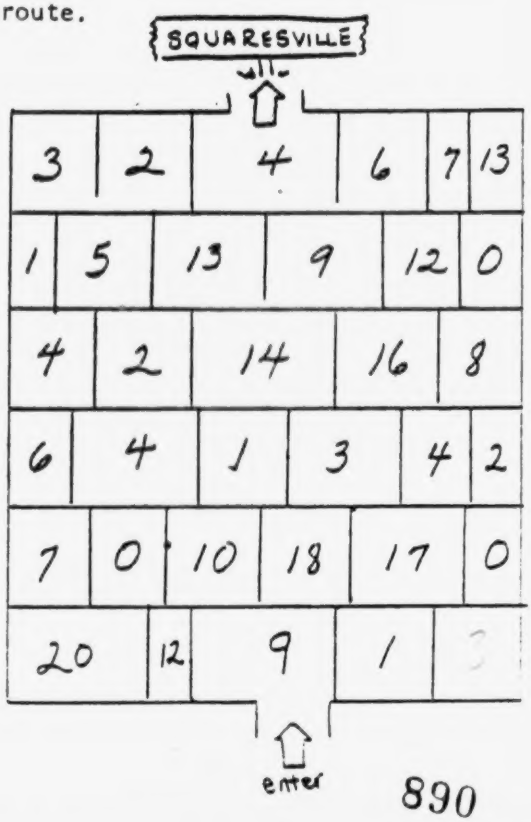
A TRIP TO SQUARESVILLE

With colored pencil or crayon, trace a path which will give the lowest possible total on the route to Squaresville. Find the sum of the shortest route.


SQUARESVILLE
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4
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7
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10
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1
3
enter

FOOD GROUPING

Charlene Modla

We use food in a lot of ways in my Kindergarten class. And of course we all love those experiences.

While working on classification, we decided to try food classification.

I used an assortment of all the things I could find in my pantry. We started by grouping them in their containers.

I explained to the students that we would be grouping them as we had previously done with attribute blocks. They soon got the idea and really did a great job of coming up with ways to group them. First they grouped by the container's color, shape and size. Then they thought about the food inside and decided to group by the size, color and shape of the food inside.

I then gave each of them three napkins and samples of each kind of food. I asked them to taste the food and then place it into groups on their napkins. I was thinking of sweet, sour and salty, but I didn't say a word. I wanted them to come up with that themselves.

I asked them to get two or three groups from their food samples, and each group had to have a name.

The students had a great time! Of course some of the tasting got a little carried away and we sometimes had to replenish some of the samples.

They did come up with the sweet, sour and salty, but they also came up with other groupings that I hadn't thought of such as, things I really like, things I kinda like, and things I really don't like; things I like and things my brother likes.

When we were finished with the grouping the students got to eat all the food that was left. Needless to say everyone wanted to know if we couldn't do this again, soon!

* * * * * * * * * *

CODED PROBLEMS

Ed Graves

We spent one evening at the BATC working with and on coded problems. Some examples the teachers made are

$$\begin{array}{r} ABC \\ +CBA \\ \hline DDD \end{array} \qquad \begin{array}{r} CD \\ -C \\ \hline CC \end{array} \qquad \begin{array}{r} ACRF \\ +BDTA \\ \hline DCFCB \end{array}$$

In any problem each letter represents a different single digit. The code changes from problem to problem. I've been putting a problem on the board first thing in the morning and telling the class to try to come up with a solution. It's fun to make your own problems and to watch how some students try to solve them.

Our six year old son was watching me make up some problems one evening and asked what I was doing. I gave him a problem I thought he might be able to solve, $\begin{array}{r} A \\ +B \\ \hline C \end{array}$ His answer was $\begin{array}{r} 1. \\ +2 \\ \hline 3 \end{array}$ His reasoning was A is the first number, B the second and C the third. So I then gave him $\begin{array}{r} A \\ +C \\ \hline D \end{array}$

Once again he assigned 1 to A, 3 to C, and 4 to D.

Make up some problems of your own, then ask the students how they arrived at their answers. You're likely to be surprised at their answers. Don't be afraid to give problems with no answer. These can be even more interesting.

PRIMARY CHILDREN AND COUNTING

Norma Whited

In the very beginning the most important concepts needed by young children are those of counting and applications of counting. There will be no firm foundation laid for further study in mathematics if the child does not have a thorough understanding of this concept. In this early period, especially, children should be involved in active learning. A multisensory, individualized approach is important.

Nearly all children are exposed to various experiences of matching before they enter their school years. Dressing (using buttons and button holes) and setting the table are two very common examples. The classroom can continue and extend these experiences. Comparing the number of objects in two sets, cups to saucers, is preliminary experience for counting. It is recognizing that 4 toys, 4 cups, 4 books and 4 pencils have one characteristic--fourness--and these sets can be matched object-by-object or one-to-one. Since counting is giving a number name to each object of a set, the child must be given real objects for him to handle so he can touch each object as he says a number name. Children must understand that the order of saying the number is important but the particular assignment of names to objects is not. To illustrate: When counting 5 pieces of candy, a young child picked up each piece saying, "1, 2, 3, 4, 5." When 2 of the pieces were knocked onto the floor, the child was asked, "How many pieces do you now have?" He replied, "1, 2, 5," as he picked up each piece. "You have three pieces--1, 2, 3," he was told. Being very upset he said, "3 is on the floor."

Cardinal and ordinal aspects of numbers often confuse children. After counting out 5 blocks, Billy was asked to show the set of 5 to his teacher. He picked up the last block he had counted and said, "Five." The fifth object counted in a sequence was confused with the recognition of 5 objects in a set.

When a child can count a set of objects easily the teacher must find out whether he understands the concept of conservation of number. The number of objects in a set remains the same no matter how the objects are arranged within the set. To check this take 8 cups and 6 saucers. "Are there enough cups to go in all the saucers?" Ask him to find out. With one cup in each saucer, remove the surplus. Then place the six cups close together and spread out the saucers. "Are there still enough cups to go in all the saucers?" If he says there are enough, ask him why. When he answers, "Yes, because I put one cup in each saucer," it indicates that he has grasped the concept of conservation of number.

There is no point in trying to help children learn basic addition and subtraction facts until they understand the concept of conservation of numbers.

Children need to discover the number relationships by first hand experience using real objects. Oftentimes this experience must be repeated over and over again.

When the child learns mathematics in this creative way he is (1) provided the opportunity to discover the order, pattern and relations which is the very essence of mathematics in the man-made world as well as the natural world, (2) trained in the necessary skills, and (3) free to think for himself.

No one really knows how much mathematics children can learn. Assigning certain topics and skills to particular grade levels has stifled thought and destroyed enthusiasm. It has been a straitjacket that has bound our children for too long.

* * * * * * * * * * *

TEACHING WRITING

Judith Harnetiaux

One of the ways to teach and familiarize first and second graders with writing is to have them tell a story while someone else--a volunteer or an upperclassman--writes it out. This is similar to the Language Experience method of Reading. The main difference is that each child tells his or her own story. It is not a class endeavor (individual versus group).

After the story is completed, the student then copies each word of the story on a 3 x 5 index card(s). He has a word box (recipe box) that (s)he uses to file each word alphabetically.

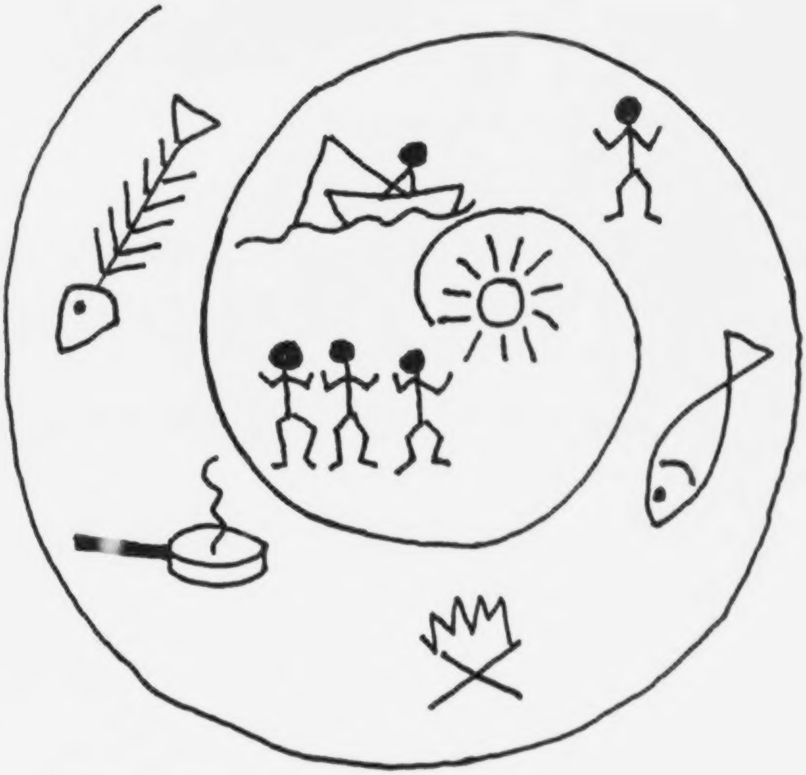
Given a first story, children should, by using his or her own cards from the word box, be able to reconstruct the original story and to generate new ones. Children continue to use the word box for each new story. This is a valuable learning technique which uses sorting and classifying and generates oral and written language. It removes the discomfort many students experience when they are asked to write.

PICTURE WRITING

Cindy Blumberg

During the month of November, my second graders begin a unit on Indians. The children are exposed to stories, filmstrips, and dittos about Indians. The children also make an art project using Indian symbols.

Near the end of the unit, I give the children a picture writing ditto (source unknown). Pictures are printed around a spiral and the children are to write about the pictures. The writing at the top of the ditto says: Can you read this picture letter? Start in the center and go around. Print what you think it says on the lines under the pictures.



The different responses are very interesting. Some of the children followed the pictures in the order of the spiral and made a story with sequence. Others used the pictures and made a story but put them in any order. Some children just listed the pictures. Still others had trouble correlating the pictures with any meaning. Some children had elaborate sentences while others just had words or phrases. The variations of creative and cognitive levels of the children were very apparent from the results of this assignment.

And here are the children's responses:

> One day three men went fishing one man cath a fish then
> they fride the fish in a fishpan and ate it.

> I saw a fishbone and a pan I love the mose wus a fireplaces.
> and I saw a sail boat and three boys and a boy and a fish.
> I saw very well was a sun.

> To Little Indians fished in the oashin. they cut a
> fish and took it home for dinner. they made a fire
> then they put it in the pan and cooked it for dinner.

> One day three wen were working one up then wer fighing the
> oter tow wen home the man coat a fish and cocked it over
> a fire and in a pan and ate it.

> The sun is bright and three men are going somewere one
> man is going to fish one aonther man is going for a
> walk. The man you went fishing he caught a big fish
> now he is going to roast it and the fry it. It was
> probley very good!

> Thers a fish bone and a pot and some [illegible] and a fish
> and a person and a conoe and three poeple and sun.

> I went fishing I coat a fish on a sunny Day. We cooked
> the fish over the fire. on a pan and we aet the fish.

One very hot morning three yong men about 21 were going to go fishing. One of the men went fishing he cout a fish. He made a big fish. The fish was put in the pan that the men had. It was very hot. After that they all ate it and it was very very good. THE END

The Indians look at the sun. It get to bright so they set sail. One Indian was going to fish in the ocene he cot a fish when they got to Land they made a fire. and they cooked the fish and ate it.

One day three Indian danced in the sun. Then one went to go fishing and he kot a big fish an then he got home. And cooked the fish in a pan. An then he ate an then all that was left was the bones.

Plain Indea
ns

The sun was sianing the Indeans wher happy and one went fishing in a pond. He came out with a fish and a big one. they made a fire and coocked it and thay eat it for dinner

It is sunny. Get some men to go fishing. One man caught a fish. He will cook the fish on the fire. He will cook it in the pan. Everyone loved the fish so much that they ate it all. The End

It is a sunny day one doy is going for a ride in the knew. One boy is going fishing. The boy says cook the fish. heres a pan to cook the fish in. Then they eat the fish up ecepect the bones.

Wons thar Was a Indian named Littile Owl him and his Frend went to take a ride in a boat. and then they went fishing then they did a dance then they cooked the fish in a pan over the fire Then They got up and all thar was a fish bone They went to bed and They wocke up and the sun was up and They went to play. The end

The sun was out. And the three men were out hunting. One of the other men was fishing. One man saw him and said Hi. The man fishing cought a fish and cooked it in a pan. and threw away the bones.

Sun people bote person fish fire pan bone

dedFish cooking Fire Fish Parsen Fishing people Sun

We ate fish for lunch and cooked fish for dinner. Father caght the fish in the lake with some other Indians in the sun.

On a suny day three men went fishing on a boat one man cot a fish and they mabed a fire and put the fish on the pan then it was bone and the men aet the fish in tell all that was left was the fish dones.

Fall is coming and man is Fishing and I hope taye cach they mene taye can.

The Indian boy is named Little Owl. One day Little Owl put on his moccasins and leggings.

We eat fish and the fish was ber. The pan was hot and it was boyling. fire, fire, fire. The tepees are on fire. We got the fish and cookct it for dinnr. The men and women are dansing a roude ter tepee.

The little boy's in earth and they saw all the thing's. Do you now what they said. I see a sun, boy it is hot said a boy And I'am hunngy. And they were talking about food- Because they were hunngy. The boy's want to go home. But they couldn't go. Because they had to see all the thing, OK said the boy's they saw a fish that was just bones and a fish with meat on it and a pan. And a fire. And to grils. Ha I have an Idiae. You no the fish that had meat on it yes and the fire yes. Will thet's cook the fish. With the pan and the fire OK! and they cook the fish.

HINTS ON MAINSTREAMING

Jeanne B. Montaldo

The author was working as an aid in the St. Louis Special School District during her participation in the River Bluffs Teachers' Center. This article springs from her observations.

A few guidelines for the regular classroom teacher are needed in order to reduce frustration with the mainstreamed child and to coordinate services for that child with the Special School District. For those teachers who have not yet taken advantage of inservice programs for working with mainstreamed children, the following tips are offered in hopes of bridging the gap until you can participate in such a program.

1. Make every effort to make the child part of the class and part of the class work.
2. Mainstreamed children sometimes are extremely quiet and pretend to be busy in order to become inconspicuous. Walk over to the child's desk whenever possible and see what is really happening.
3. Mainstreamed children usually don't get down to task. If you can, quietly explain the work assignment personally to him/her or enlist the aid of a peer.
4. It is less discouraging to the teacher and the child if expectations are lowered on sentence structure.
5. Realize that it is possible for a learning disabled child to make no measurable progress during a school year. In rare instances some are even known to regress.

6. Understand that every effort must be made to help them to progress. Avoid the slogan, "If you want to fail, fail quietly."

7. Become acquainted with and use Special District services.

8. Learn each child's I.E.P. This will enable you to learn their weaknesses and teach to their strengths.

9. Avoid making public demands which the child is unable to meet.

10. Behave toward the child in ways which are encouraging. Avoid negativism.

11. Never allow the child's zero performance to pass unnoticed.

12. Use tapes (available from Special District) to help the child get chapters read.

13. Learn that silence in class participation is not necessarily a sign of indifference. It is often a sign of figuring things out.

14. Following directions requires a good memory and sequencing ability. Both abilities are often limited in the L.D. child.

15. The presence of a mainstreamed child should not be seen as a threat to the competence of the teacher. They are special people who need to learn what they can with your help.

16. Mainstreamed children do not "belong" to the Special District. They are your students.

17. Let the children follow their Special District schedule as regularly as is possible.

18. Let the Special District work on the skills the child needs in order to keep up with your class.

19. Whenever possible give Special District teachers a few days advance notice of tests or special assignments.

20. Mainstreamed children need the social modeling that mingling with normal children provides.

21. The bottom line of mainstreaming is to think of the child's alternative. These are often borderline performers whose alternative is to be mixed with more severely handicapped children. Help make a real place for him or her in your classroom.

* * * * * * * * * *

MATH IS FUN?

Karen Botterbush

While the teacher was getting the TV ready for the Space Shuttle launch, I tried some of the games I learned in the Teachers' Center. "Using fingers on both hands, will you show me the number 5." What a success! They were so surprised to see what they were able to come up with. Little did they know they were learning math, the subject that they booed and hissed when the teacher said, "Take out your math books." The children were interested to see how many ways they could come up with the number 5 with their two hands, the same hands that the teacher said not to use to count and add with. The regular teacher was amazed to see how excited the class was. This made the teacher excited! She learned that learning math didn't have to take place in a book. After using our fingers everyone took off their shoes and used their toes! What fun!

A TRIP TO LUBBER LAND

Joan Waggoner

Here's a story prepared for Collaborative Cloze Writing. Children can work in groups of three or four to argue out a "best word" for each blank and then compare results. Try it!

See Seedbed 5 for other examples of Collaborative Writing.

I will never forget my trip to Lubber Land. ________ was long, long ago, when houses could fly like ________, and when rabbits could talk as well as you _______ I. It was the time when foxes and squirrels ___________ together and snow was black. It was when tadpoles _________ in beehives and wasps lived in ponds.

I'm sure _________ won't believe the things I saw in Lubber Land! _______ could you, if you have never been there?

As _________ walked down a road, I met a goat. It ________ coming from the flour mill with a hundred sacks ___________ Flour on its back.

As I walked on, I _______ to a tree. I am sure you have never _________ such a pretty sight, for it was a pancake __________. Oh, how the bees were buzzing around it!

Pancakes _________ growing like leaves from the tree. And the pancakes __________ hot with melted butter on them. Under the tree _____ a jar of jam, all ready for a pancake _____________.

Oh, what a feast that was! Lunch and dinner _________ day were real treats.

I came next to a ___________ where animals were baking cakes. Two brown donkeys had ___________ the wheat into flour. Three little pigs had mixed ________ with milk and eggs to make the cakes. And a black cow was sliding them into the hot oven.

_________, yes I must remember to tell you that the _______ and pigs had on red shoes--not black shoes, _________ pretty red ones. And the cow had a hat _________ yellow flowers.

I saw even more, but you would ________ believe me if I told you, would you? But I will tell you anyway.

I saw a forest cutting ________ its own trees, one by one. Have you ever ________ of such a thing?

And I saw a big __________ with no farmers. The farm was plowing its own __________ and planting its own seeds. And the plows needed __________ oxen to pull them.

And there is one last ________ I just have to tell. In all of Lubber _________, not one rooster could crow. But early every morning, __________ as the sun came up, all the hens cried __________:

Cock-a-doodle-doo, my friend.
Now this silly _________ must end.

(Adapted from Going Places, Seeing People [A Trip to Lubber Land], Harcourt Brace Jovanovich, Inc.)

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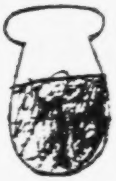

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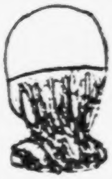

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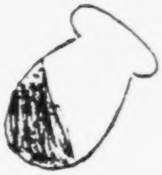

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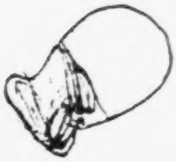

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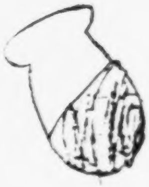

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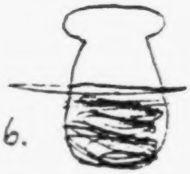


METERS, INCHES, YARDS, FEET????????

Helen L. Miller

33. 77 feet

How many yards?

How many feet left over? (Heath, p. 231)

1. Measure off 40 meters on the playground. (Heath, p. 317)

* * * * * * * * * * * * * * * * * *

Are these the kinds of problems that your students have some difficulty in comprehending? Do they have a workable understanding of the concept of measurement? Or do you find a few children who look at you with rather glassy eyes and blank expressions?

In my class I seem to have a predominance of the glassy eyed, blank expression types when it is time to determine a particular problem in measurement.

After much time spent muttering to myself, gnashing my teeth, screaming a bit, and then resigning myself to the fact that the next teacher would have to teach them, I decided to get out the large ball of string and start from the beginning. I gave each child a piece of string and we began measuring everything and everyone around us. I carefully helped them find the point from which to begin measuring and watched to see that they all were using the information as they measured items. After they got a measurement we carefully recorded it by putting the string against the chalk board and following the string with the chalk. Then that particular measurement was labeled as to what the item was and who had done the measuring.

After some time spent in this type of activity, we ran out of room on the chalk board and were forced to find another spot on which to record our results. What could be better than the floor? I got out the masking tape and made a base line for each of the measurements. As the children brought over their findings, we laid one end at the base line and followed the string (this began to turn into a measuring stick (meter stick) as the children found that the string was so cumbersome for long areas) with a piece of masking tape. The tape was very handy because we could write on it in the same way we recorded the information on the chalk board. What was even more interesting was that this turned out to be a very interesting bar graph!

The children at the end of the time had a very visual picture of the comparative lengths of tables in the room, and how that length compared to things such as the mirror. There were many concepts that were reenforced by this simple measuring activity, and, I hope, new concepts that were beginning to be assimilated. And we had fun doing in a very cooperative manner!

Another interesting aspect of this project is that it was done by a group of very average children, the majority of whom are four and one-half and five years old!

Reference: Rucker, W., & Dilley, C. Heath Mathematics. Lexington, Mass.: D. C. Heath & Co., 1979, 231, 317.

Note: This is not a textbook that is used in my kindergarten. The problems were used only for the purpose of illustrating a point in the article.

* * * * * * *

THE 104 NEWS

or

"WHAT DID YOU DO IN SCHOOL TODAY, DEAR"

Linda McDonnell

This is the usual question from parents as students return home from school. The usual answer from students is "nothing." After participating in the summer session at the Teachers' Center Project, I wanted the parents of my class to be informed of what we were doing. I thought about periodically sending a newsletter to them. Then I got the idea to have my students write the newsletter. And this was the beginning of "The 104 News." (Our room number is 104.) The growth of this idea with my second graders has been amazing!

The first copy was just two pages and did not include work from all of the students in my class. From this meager beginning, "The 104 News" has grown to an average of six pages, with every student contributing at least one article. Some students write more. The "News" includes original poems and crossword puzzles, graphs of everything, jokes, mazes, special messages, want ads for household things we may need in the classroom, and others. (See list at the end of this article.)

The "News" has progressed from being teacher edited to being student edited. Initially, I helped with spelling and punctuation and I occasionally helped with ideas if someone was "stuck." Now, one of my students has asked to help edit, and he has become the new editor. I am now the advisor.

Through writing the "News," the students have seen the need for correct spelling and punctuation. They want to be understood by all their readers--their classmates, their parents, and especially themselves.

The children's writing has improved. Because they write regularly, it has become easier and less threatening. The students have gained confidence. They have come to know the pride of accomplishment and of seeing their names in print.

As more improvements are added to the "News," I probably won't be needed--except to run the ditto machine!

THE PAPER

"The 104 News" is a weekly newsletter. It goes home every Friday. Here is what happens.

There is no formal writing or English class on Friday because Friday is "newspaper day," and my students eagerly look forward to it. On Thursdays our south blackboard becomes our article board. I divide the board into a checkerboard of boxes, about 2' x 2' and put into each box the name of something we have learned during the week. See below.

Mystery Person	Graph	Thin that Words
Joke	Addition Wheel	2 Dice Game

The students may also add articles to the board. Then each student chooses a topic and writes his name in the box. Problems of identical choices are resolved by the students themselves. I have had to limit the jokes and mazes because these are very popular. So we take turns on those. The students go home on Thursday and think about what they want to write.

The next morning the children get out their English spirals, write their article name, and then begin to write. This was not always the case. At first many students felt that they could not write because they could not spell. I told them that we were "writing" and not "spelling." I also told them that I was pretty good at spelling and could show them the correct spelling before they put their article on the ditto master. This seemed to relieve much of the anxiety and my encouragement and praise added confidence. It also helped for me to model writing an article on the blackboard. (This is no longer necessary.)

While the students are writing, I divide the ditto masters into halves, thus making a two-column newspaper. The front page has our newspaper name, the date and the number. The succeeding pages are simply numbered at the top. I now have an assistant who sets up the columns for the reporters.

As the students finish writing, they bring their articles to the reading table for editing. (All of the ditto masters, pens and rulers are at the table.) I read the article, sometimes offer a suggestion, and ask if they want help with spelling. After any spelling or punctuation corrections have been made, each student decides if his/her article is ready to copy. Using a ditto master and a pen for the copying can cause problems. But practice makes them better. When each reporter has finished, a line is drawn below the article and the page is ready for the next article.

In order to help my students spell the words that they need when they write, each student has his/her own personal speller. As the students finish their articles, the misspelled words are added to their own spellers for practice. The article is then crossed out on the blackboard. I can tell at a glance if all of the articles are completed. Occasionally a student may not want to write an article, and another may want to write an additional article. This is all right. It is important to have an environment that is both non-threatening and enriching.

Any unused space in the paper is filled with information for parents and want ads. This has become an invaluable aid for all of us. Information and messages go home, and supplies, like playing cards, poker chips, dice, games, yarn, etc., come back to school.

Then the paper is complete. All that remains is to "roll the presses." We all go down to the work room and I run the ditto machine. The students help by counting out the copies in their heads. We take the copies back to the room, assemble the papers and staple them.

The paper is finished and then the best part happens. A quiet that falls over the room as each reporter reads his/her own article with pride. Each article receives applause and we smile with pride of accomplishment. The students take home "The 104 News" and the parents eagerly read it. (I suspect that they smile too.)

One last comment: Our last paper, "The 104 News #14" was almost completely edited by one of my second graders. This paper is the best one yet! But I know from past experience that the best is yet to come . . .

SOME ARTICLE TOPICS

Book Reports with pictures

Art projects that we do

Math games

School activities (field trips, plays)

Lessons that we learn--all subjects

Movie critiques

Thank You's

Original crossword puzzles

Poems--original and others

Original mazes

Jokes

Book order news

Invitations

Graphs of everything--eye colors, favorite cartoons

Mystery person--can you guess who?

News from P.E., Music, Learning Center, Idea Lab

Articles from our fifth and sixth grade helpers

Riddles

Pet Stories

Holidays

Happy Birthday Messages

Want ads

Pictures

* * * * * * * * * * *

ACTIVITIES FROM "SATURDAY SCHOOL"

Florence A. Brennan

Since September, 1978, I have had the privilege of being able to use the Home Activities program from the Early Childhood Education Department in the Ferguson-Florissant School District (Saturday School). These home activities have been a beneficial supplement to the language, math, and reading readiness skills that I have presented to my Pre-school language therapy students. During the first year of usage, I was involved with fifteen pre-school children. At the end of the year, we noticed that all of the children increased their receptive and expressive language scores an average of 2 to 2½ years with one child moving ahead 4 years and 1 special child 6 months. Since this was not a scientific study, we do not know if this gain was due to 1) being in a highly language oriented pre-school program, 2) having a Speech Therapy language class twice a week, 3) or due to the home activities. I feel it was due to a combination of all three factors with the Home Activities playing a vital part since children are with their parents the majority of the time. The activities cover a variety of areas including Language development, Listening skills, Motor skills, Number and math skills, Thinking skills, Visual skills, and Creative Activities.

The parents have expressed the following comments concerning the materials: 1) that they are concrete, 2) that they mostly require materials presently in the household, 3) that they can be done as the parent is daily working with the child, 4) that they are on the interest level of the child. I have also found that these lessons are applicable to the older special language students who still require conceptual readiness skills work.

Attached are two sample lessons. As you can see, the first lesson is on "All About Me." I feel it is an important part of any program to begin with the child's self image and his relationship to his environment. The second attached sheet is a sample of the math activities. For the complete program please contact: Mrs. Marion Wilson, Director

Early Education Program
Ferguson-Florissant School District
655 January Avenue
Ferguson, Missouri 63135

I'M SPECIAL. THERE'S NO ONE ELSE JUST LIKE

ME!

DIFFERENT PARTS OF THE BODY AND THEIR FUNCTION:

*BODY — ALL OF YOU FROM HEAD TO TOE

*EYES – seeing
*EARS – hearing
*NOSE – smelling, breathing
*MOUTH, LIPS, TONGUE, TEETH – eating, talking
*ARM – reaching, holding
*HAND, FINGERS, – picks up, holds
*LEGS – stand, walk, run, climb
*FEET – walk, stand, run, jump

*Teach these body parts first

TRUNK – bends, twists, stretches
SKIN – covers body
HEAD – thinking
HAIR – covers head
EYELASHES – protect eyes
EYEBROWS – show expression

CHIN – allows mouth to open and close
NECK – moves head
ELBOW – lets arm bend
WRIST – turns hand
KNEES – helps legs bend
TOES – helps us stand, walk

1 A LOOK AT ME

Before a large mirror, have your child take a good look at herself — front, side, back. Can she tell you her full name? Point to parts of her body. (See above list.) Which can she name? Which does she need to learn?

Then one by one, teach her the parts she cannot name in this way:

- Touch each body part as you name it. *"This is your elbow. What is this?"* Always have her repeat after you: "Elbow."
- Then say, *"Show me my elbow. Show me your elbow."*
- Touch her elbow and ask, *"What is this?"* Can she name it? Then with her eyes closed, touch her elbow. Can she name it?

2 LOOK WHAT I CAN DO!

Is your child fully aware of the amazing things her body can do? Does she know the function of all her body parts? (See above list.)

In front of a large mirror, let your child see herself walk, run, jump, sit, bend, move her arms all about. Then one by one, talk about each body part: what it can do and what would happen if the body part did not do its job. For example:

- What does the NECK do? Turn your head back and forth. See the neck move? Hold your neck stiff. Can the head turn? Look up? Down?
- What does the ELBOW do? Eat a cookie. See the elbow bend? Hold your arm stiff. Can you get your hand to your mouth to eat?

while you're at it . . .

Take turns naming body parts as you comb your child's hair, wash her face, help her bathe, dress or undress and look through magazines or story books.

One day at a time, call attention to all the things her hands, legs, arms can do. Ask: *"What are your hands doing now?"*

Have each family member stand beside your child in front of a big mirror. Ask, "How are you like Daddy?" (Have eyes, ears, mouth, etc. Same color hair.) How do you look different?" (Size,hair length, color eyes, etc.) *This is not as easy as it sounds.*

MY CHILD CAN

___Give first name
___Give last name
___Touch the parts I name, marked X on above list
___Name the parts I touch, marked XX on above list
___Has some understanding of the things his/her body can do
___Can tell me a function of the parts marked XXX on above list

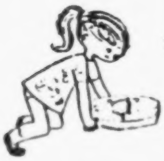
LANGUAGE

why?

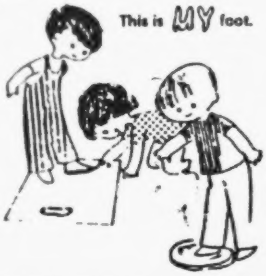
to develop a picture in his/her mind of her whole body and its parts
to learn the names of body parts
to gain an understanding of what each body part can do
to appreciate more fully how amazing his/her body is

Here are things you can do with opened up grocery bags and crayon, blackboard and chalk, a rock on concrete or a finger in wet sand. Or with play dough, concrete or mud

PLAY DOUGH.
1½ C. flour, ½ C. salt, ½ C. water
2 Tablespoons salad oil
a few drops of food coloring
Keep covered and refrigerated.



This is MY hand.

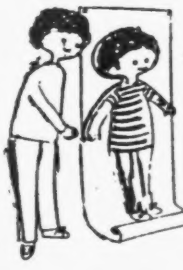


This is MY foot.

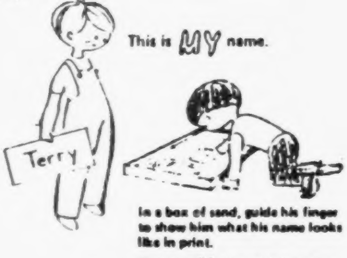
Let your child mold a thick layer of play-dough in two pie tins. Turn upside down to get the dough out. Press his hand and foot firmly into the dough. Set aside to dry.

Or if it's an outdoor weather day, he can press his hand and footprints in a mud pie!

Or easier still, trace around his hand and foot.



This is MY body.

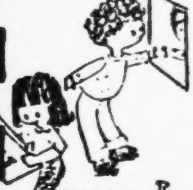


This is MY name.

In a box of sand, guide his finger to show him what his name looks like in print.

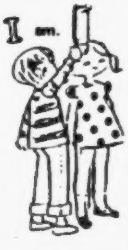
For something more permanent, mount sandpaper letters on cardboard for him to trace through the year. Some future day he'll be able to write it all by himself.

CONCEPTS

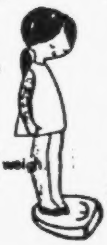


is how I look now.

This is how I looked as a baby.

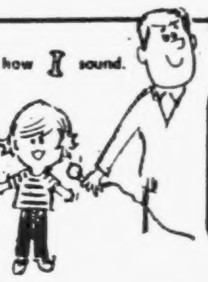


This is how big I am.



This is how much I weigh

Things you can do with a mirror, a photo album, tape recorder, tape measure and scales.

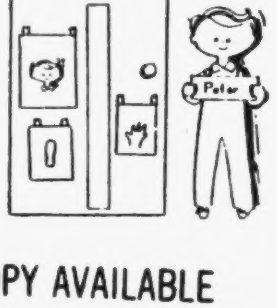


This is how I sound.

Things you can talk about on a hand-in-hand stroll through the house. At the end of the tour, tape to the door the day's collection of things about him – low where he can see it best.

. . .This is MY room, MY bed,
MY clothes, MY toys, MY chair,
MY Mommy, MY Daddy,

. . .and these are MY things that are ALL about ME!



BEST COPY AVAILABLE

c0unt1ng

while you're at it. . .

Count all kinds of alike things every chance you get. Crayons, marbles, blocks, toes, fingers, elbows, teeth, candy, cookies, crackers.

At the supper table, count the people, chairs, plates, cups, glasses.

Count the humber of steps you take as you walk to the car or go from room to room.

Listen to some lively music and count, 1–2–3–4–5 with your child as she claps her hands in beat with the music.

MY CHILD CAN

Count from memory
—1 – 5
—6 – 10

Make counting trains using
—1 – 5 items
—6 – 10 items

why?

to help your child learn to count

and to

understand the meaning of numbers.

1 NUMBER RHYMES

Five Little Monkeys

Five Little Monkeys* jumping on the bed
(hold up 5 fingers, move hand up and down)
One fell down and bumped his head
(hand to forehead)
They dialed for the doctor.
This is what he said:
(finger dialing phone)
That's what you get
for jumping on the bed.
(angrily shaking forefinger)

*Other verses: 4 monkeys, 3, 2, 1.

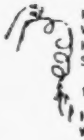
One-Two Touch Your Shoe

1 – 2 touch your shoe
3 – 4 touch the floor
5 – 6 big high kicks
7 – 8 arms out straight
9 – 10 do it again

Also try:

One Two Buckle Your Shoe
Ten Little Indians

Beehive



Here is a beehive.
Where are the bees?
Hiding inside where nobody sees.
Soon they'll come creeping
out of their hive,
1–2–3–4–5. Bzzz. Bzzz Bzzz.

Here is a beehive.
Where are the bees?
Hiding inside where nobody sees.
Soon they'll fly outside
to zoom and dive.
6–7–8–9–10. Bzzz. Bzzz Bzzz.

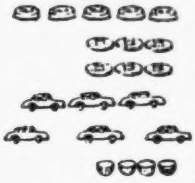
2 A – COUNTING

Button Toss Have your child drop or toss 5 or 10 buttons into a pan or bowl, counting out loud as she tosses each button.

Pick-Up Jacks Spread 6 or 10 jacks on the table or floor. Have your child pick up the jacks one by one with a spring clothespin — counting as she does, 1–2–3–4–5.

3 COUNTING "TRAINS"

Make counting "trains" using toy cars, bottle caps, pennies, spoons, cups, little animals, etc.



. First, you make a counting train — make it any number from 1–5 (or 6–10). Have your child touch each item as he counts.

. Next, you make a number train and have your child make a number train just like yours, counting each item as he sets it in place.

. Then you make, for example, a number 3 train, placing the cars close together. Have your child count them. Then spread the cars about 6 inches apart. Ask, "How many are there now?" (Sometimes when things are spread apart, the child thinks there are more.) Help him count them to see that there are still the same number of items.

. Now ask your child to make a 4-item "train," a 2-train, a 5-train, etc. Can he do it without your help?

4 COUNT 'N CLAP

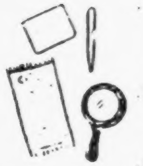
Ask your child to clap as he counts (out loud) the number of . . .

people in your family, chairs in the kitchen, marbles on the table, crayons in the box, rooms in the house, etc.

(This is more difficult than it seems. Your child must think, clap and count at the same time.)

ROUGH SMOOTH

GET ROUGH!

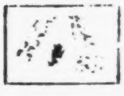


. First help your child understand what ROUGH is. Have him look at and feel something ROUGH, like sandpaper or a nail file. Then take a walk inside (and out, if weather permits) and simply talk about and feel rough things — a food grater, towel, straw basket, window screen, stucco or brick wall, tree trunk, tire tread, etc.

. When your child understands ROUGH, then talk about SMOOTH things in the same way — feel a glass, plate, mirror, windowpane, pan, refrigerator door, plastic things. Clothes are rough and smooth, too. Feel them and see.

. Have him close his eyes and just feel some rough and smooth things. Can he tell you which is smooth and rough by feel alone?

RUBBING IT IN!



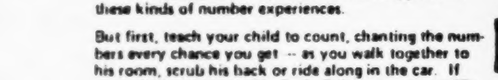
. Look indoors and out for things that feel rough or bumpy to the touch — leaf, tire, brick wall, bark of tree, sidewalk, etc. Look for some smooth things, too. Keep asking, "Does it feel ROUGH or SMOOTH?" Have your child carry a big piece of paper and a crayon with him. Have him place it over the surface and rub. Watch the pattern appear on the paper like magic!

. Or make a collage. Collect some rough and smooth things — leaves, gum balls, bits of tree bark, screen wire, satin, cotton, aluminum foil, waxed paper. Paste them to a big piece of heavy paper, perhaps an opened up grocery bag.

. Can he look at rough and smooth things and tell you it will be SMOOTH or ROUGH even before he touches it?

why?

All surfaces have a texture. Some are ROUGH. Some are SMOOTH. Help your child see and feel the difference by looking and touching ROUGH and SMOOTH things.



Children can often say, "1–2–3–4–5" in the right order, yet not realize that each number has "value" — that each number stands for so many of something. That number one stands for 1 ball; two means 2 balls; three, 3 balls; etc. The best way for your child to learn the meaning of the number names is to count things, anything, touching each as he counts "1 – 2 – 3 – 4." Games 2 and 3, inside this leaflet, provide these kinds of number experiences.

But first, teach your child to count, chanting the numbers every chance you get — as you walk together to his room, scrub his back or ride along in the car. If your child miscounts "1–2–4–5," do not say gruffly, "That's WRONG, Jimmy. Count again." Simply count for him slowly, saying the number he misses in a louder voice, "1–2–3–4–5." Start with numbers 1 through 3 or 1 through 5, then progress to 6 through 10. If your child can count to 10, try 11 through 20.

SATURDAY SCHOOL HOME ACTIVITIES

Ferguson-Florissant School District
Parent-Child Early Education Program

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in this issue 8

c0unt1ng
ROUGH SMOOTH

LETTERS, LETTERS, LETTERS

Helen L. Miller

Teacher: "What is the alphabet?"

Children: "A,B,C,D,E,F,G,H,I,J,K,L,M,N,O,P,Q,R,S,T,U,V,W,X,Y,Z."

Teacher: "What do we need to learn those letters for?"

Children: "'Cause."

Teacher: "Did you need to know those letters before you came to school?"

Jonathan: "No."

Teacher: "Why do you have to learn those letters now?"

Rhonda: "So you can grow big."

Teacher: "When you were a small baby did you have to learn those letters so you would grow big enough to be able to come to school?"

Teresa: "So you can tell your little brother."

Jennifer: "So when the first grade teacher asks you, you can tell her."

Teacher: "But why does she want you to know them when you get to first grade?"

Rhonda: "But you have to know them to be big."

(There is then a period of complete silence and a preponderance of perplexed looks on the faces of the children.)

Teacher: "Scott, will you please write your name on the chalk board?"

(Scott willingly complies with the teacher's request.)

Teacher: "Thank you, Scott. Will you tell us what the first letter in your name is?"

Scott: "S."

Teacher: "Jamie, will you find the letter that Scott's name begins with on the letter line and tell us what it is, please?"

(Jamie quickly finds the letter on the letter line which is the letters of the alphabet placed in consecutive order under the chalk rack.)

Jamie: "S."

Teacher: "What is the next letter in your name, Scott?"

Scott: "C."

Teacher: "Randy, will you find the next letter in Scott's name on the letter line and tell us what it is, please?"

(Randy with some hesitation, goes to the letter line. After moving back and forth a few times, and with the help of clues like "hot", "cold", he finally finds the letter "C". Scott reminds him that the name of the letter is "C".)

Teacher: "What is the next letter in your name, Scott?"

Scott: "TT."

Teacher: "Jeri, will you find the "t" on the letter line, please?"

(Jeri finds the "t" and identifies it.)

Teacher: "Have we found all the letters in Scott's name?"

Children: "Yes."

(There is one small voice that hesitantly says, "no".)

Teacher: "Do we need to find another letter?"

(Again the small voice says, "There are 2 "t's" in Scott's name.")

Teacher: "Sarah, will you find the last letter in Scott's name for us and tell us what it is, please?"

(Sarah goes to the letter line and points to the "t", but there is a look of concern on her face.)

Teacher: "Why do we have to know letters?"

Children: "So we can write our name."

This exercise took place in my kindergarten class today as we ventured into the concept of the alphabet. Each year, with each class, the reactions and responses of the children have been the same. At the kindergarten, pre-operational level, of development children are able to identify words before they recognize individual letters. They do not yet have the visual acuity to focus in on the internal structure of the words that they are able to recognize, such as their own names, the names of their friends, the words printed on cereal boxes, street signs, signs on buildings with which they are familiar, words all around them in their environment.

Dr. Frank Smith in the recent lecture given at SIUE said that learning to read should be as natural a thing for a child to do as learning to speak and communicate. Why, then, do we persist in requiring a child to learn the letters of the alphabet?

Would it not be far more logical to saturate the classroom with words necessary for his everyday life? Wouldn't it be more efficient to use words to communicate with children--written words that are meaningful to what he is doing or required to do--in order to stimulate his interest in reading? Surely it would be easier for both teacher and child to work within a child's capabilities than to force the child to learn something that makes no sense and seems to be utterly useless.

There is no question that the alphabet must be learned in order to build vocabulary and expand reading ability, but the child who knows the fun and rewards that reading can bring is very eager to learn the alphabet. The child who can recite the alphabet forwards and backwards, who can instantly recognize letters and name them, is not necessarily the child who will read well, or who will ever enjoy reading.

Adults who presume that age or education gives them the right to dictate how children will learn to read and who are given credibility by having their names listed as the authors of textbooks should take another look at how children think and what makes sense to children. One or two days in a typical classroom situation might give them an entirely different perspective on how children learn--provided that they looked at the faces of the children and listened to what the children were saying!

I am not advocating sight reading. I know that children learn to read when reading is necessary to their environment and is a part of that environment--a natural part. There is a boy in one of my classes who reads on the third grade level. He did not learn to read by reciting the alphabet. He learned to read words that he was interesting in learning. He reads because it is fun and exciting! The alphabet does not seem too exciting if you do not know what to do with those letters!

One last thought--what does the letter "z" have to do with the letter that you put in a mail box--they are both called the same thing, "letters?"

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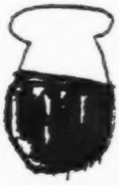

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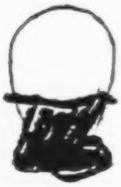

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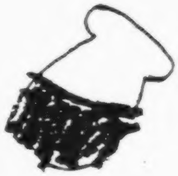

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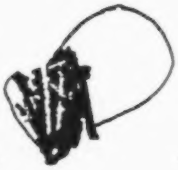

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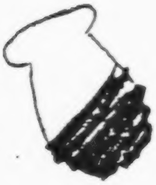

6.

EFFICIENCY

Cynthia Wiegand

"Americans who are concerned about their schools and who understand that the future of our free society depends upon the quality of education our children receive must realize that as a result of the developments in educational administration since 1911 we are, in the 1960's (and maybe more so in the 1980's), caught in a vicious circle. The continuous pressure for economy has produced a situation in which many men with inappropriate and inadequate training are leaders in our public schools," states Raymond Callahan in his book Education and the Cult of Efficiency.

In his book, Callahan develops several lines of thought. First he explores the origin and development of the adoption of business values and practices in educational administration. Then he studies the actions administrators took between 1910 and 1929 in applying business and industrial values and practices to education and tries to explain why administrators followed this course. Next he discusses the leaders who were influential in developing educational courses and training programs for administrators during the early formative years. In addition, he provides evidence to support the fact that developments which occurred in "the age of efficiency" are still influencing education. Finally, he offers solutions to the problems facing American education today.

At the turn of the century, in an effort to cope with the problems of rapid industrialization (such as the rising cost of living and the elimination of economic waste) modern business methods and efficiency measures became popular. There were hopes that the management of industrial business as well as other American institutions would improve. In 1910, "scientific management" or the "Taylor" system as well as efficiency experts became a part of American society. According to Callahan, "Taylor had developed a system for getting greater productivity from human labor. In his system, the judgment of the individual workman was replaced by the laws, rules, principles, etc., of the science of the job which was developed by management." Because of the publicity given to scientific management's ability to eliminate waste, the public became more critical of institutions supported by taxes.

Since public schools were tax-supported, superintendents were vulnerable to public opinion and pressure. "As the efficiency mania spread and the criticism of education grew, the job security of superintendents decreased," according to the author. To save their jobs, superintendents began using "efficiency procedures" such as utilizing "objective" achievement tests in language arts and arithmetic and in developing scales for rating the efficiency of teachers. School surveys were developed whereby an outside "expert" would study the schools and make a report to the board of education. In most instances, the motivating force of the surveys was economic not educational. The "Gary Plan" or "platoon school" was an effort to use school facilities more efficiently. All rooms in the school were in constant use. Increased record keeping, accounting, and cost analysis indicated further influence of business values on education. Increasing class size and teaching loads, eliminating small classes, and building larger schools, were further economy measures. Superintendents became business managers instead of educators.

Not only was the business world influencing the superintendent, but educational leaders in the universities were actively teaching business procedures and terminology in training courses. They centered classes on financial, organizational, and mechanical problems. Topics of doctoral research for administrators included such studies as "Analysis of Janitor Service in Elementary Schools"; "Public School Plumbing Equipment"; "Principles of School Supply Management." Leading educators did not emphasize courses such as teaching-learning process, evaluation of instruction, psychology, or philosophy since this would not help superintendents in facing public pressure.

Callahan states that education is still feeling the effects of the "age of efficiency." Doctoral candidates applying for jobs today frequently have heavy concentrations in courses labeled "school administration." Present day textbooks in administration give much more attention to finance, business administration, school plants, and organizational problems than to the instructional program. This same pattern can also be seen in journals of school administration. School boards say superintendents are doing their best work in finance, personnel, and school plant management and their poorest work in instructional direction.

To reverse this trend in American education, Callahan suggested (in the 1960's) the following:

1. Students in education should be required to have knowledge in such areas as history and philosophy or in the social sciences, especially psychology, social psychology, and sociology.
2. Institutions should require serious disciplined study and high standards of scholarship for their highest degrees.

3. School administrators should be required to have an excellent education at the graduate level. This should include residential study in which students are required to read and study seriously in the social sciences and in the humanities as well as in their professional work.
4. The quality of graduate work in educational administration must be improved.
5. Superintendents must be given a reasonable degree of job security and be provided with adequate funds to enable them to develop a fine educational program.
6. We must get bold and vigorous leadership from prominent persons in public life, including the President of the United States.
7. We must get strong financial support from the federal government because many local districts and even many states do not have the necessary resources.
8. Administrators must have professional competence necessary to evaluate instructional efforts.
9. We must learn that saving money through imposing an impossible teaching load on teachers is, in terms of the future of our society, a very costly practice.

Callahan, Raymond E. Education and the Cult of Efficiency, Chicago: The University of Chicago Press. 1962.

OBSTACLES TO EXPERIENCE BASED CLASSROOM

Sally Bolen

The method of teaching advocated by the participants of the Teacher's Center Project is presented as being the best way for children to learn and proof is provided. Why are all schools not now involved in experience learning for children? I have observed three obvious obstacles and there are many more. Usually a mixture of more than one of these points is at the base of teachers' reluctance.

The first obstacle is peer pressure. Other teachers prefer you follow the normal procedure: desks in neat rows, books the primary source of learning, paper and pencil tasks the means of evaluation. Quiet is the normal atmosphere and there is usually a movie on Friday afternoons. A teacher who lets the children learn at their own pace is sometimes given a list by the teacher in the following grade. The list gives requirements that the students should all have reached before being promoted. The inference is, in my opinion, "I don't care what you play all year long but squeeze in at least this much work." I am not even sure if the teachers in the next grade believe it is possible to fulfill the requirements he or she has put forth.

The next complaint that the teacher of the next grade may issue is that "You are teaching my stuff." Children will not stop with learning third grade things in third grade if they are given the opportunity to learn as much as they can. That puts the fourth grade teacher in the position of having to come up with new, more advanced material.

A second obstacle is parent pressure. Parents are not familiar with classrooms in which the children learn by experience. If there are few textbooks to study, no rows of problems to work in math, no batch of papers with grades on them sent home, they fear that their child is being cheated. They feel more comfortable with education similar to their own. They feel that their own education was sufficient and they want their children to have the same education.

The last obstacle I will observe is that experience education amounts to too much work for not enough pay. For the teacher who is also the main salary earner, this is not a small complaint. A teacher's salary is not large. It is usually insufficient to support a family of four or five members. That may mean killing off one or more members of the family or (more likely) getting a second job. Popular opinion is that active learning takes more of the teachers' time. If that teacher is working two jobs or has home responsibilities after getting home, the ones who suffer are members of the teacher's family. Some feel that price is too high to pay.

These are just a few of the reasons a teacher may not have active learning in his/her classroom. They are all valid to the teacher who feels pressure from one or more of these areas. Administration support could make the first two areas vastly easier and community support for better pay will make the last easier.

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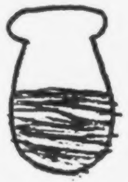

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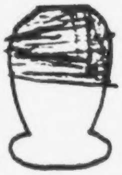

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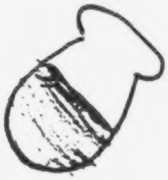

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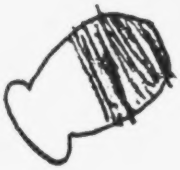

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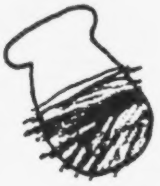

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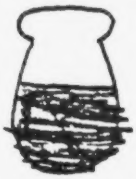

CREATIVE THOUGHTS

Linda VanValin

I have found that creative "writing" is a very rich activity even for Kindergarten children. Most children cannot express themselves with a pencil at this age, but a tape recorder can be most valuable in capturing their spoken thoughts.

Holidays and the four seasons are good times for the children to express their thoughts and feelings.

I usually do the writing for the children and they sign their own work. We compile these writings into books for the whole class which can later be used for reading assignments.

The following are some of the poetry writings the children created about Spring:

The Wind

I like the wind
When it blows real hard.
The trees look like they are dancing.
I feel like I might blow away.

The Wind

It feels cold.
It's very strong.
It blows left or right.
It blows the leaves.

Springtime

In the Springtime I see butterflies.
In the Springtime I see birds.
In the Springtime the grass grows.
In the Springtime I feel windy.

Birds

Birds have wings.
Birds lay eggs.
Birds are red.
Birds look pretty.

Springtime

In the Springtime baby animals are born.
The flowers are growing.
The grass is turning green.
I think Spring is pretty.
It makes me feel happy.

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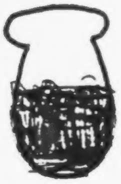

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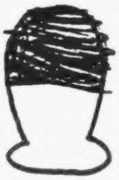

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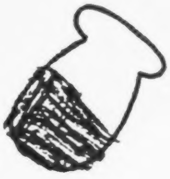

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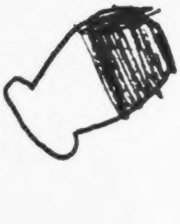

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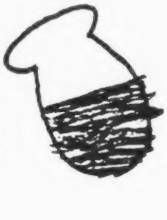

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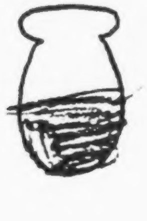

LEARNING THE LANGUAGE OF MATH

Peggy Read

Seven children had been at my desk and, in response to my request to show me the middle of a circle, had placed a dot squarely in the center. But, the question, "How do you know that's the middle?" brought only shrugs and vague responses. Trying to help them clarify their thinking, I placed a dot off-center and was quickly assured that that was not the middle. Still, they could not explain. Could it be that these children did not really understand. At first it seemed so, but they had been so positive in their selection, and so sure that I was wrong! Another explanation seemed possible.

A few days later I asked each member of the class to order a set of cuisenaire rods. Each child did so easily, but none was able to respond to the request to explain what they had done. In answer to, 'Why did you put this one here?", they could explain that it was shorter and/or longer than the others, so it was obvious that they had seen the relationships. They could not, however, explain them.

On still another day, as a child and I counted out 12 chips and she was able to tell me that there were seven of them hidden under my hand, I asked "How did you do that?" She didn't know. When I rephrased the inquiry and said, "Tell me how you know there are seven," she replied, "That's easy, 5, 6, 7, 8, 9, 10, 11, 12." Obviously she knew how she had gotten the answer. She counted. She could not, however, verbalize the method she had used. Other children were unable to tell me that they had added, but could say, "Five and seven more are twelve," or could not tell that they had subtracted, but could say, "You have twelve and you take away five so seven are left." The problem did not seem to be one of not understanding so much as not being able to explain.

It was not a problem of math, but a problem of language. How to help them to develop the language of math?

Let's begin with the development of language in general. That we can think without language is evident by the fact that we sometimes must search for the words to express the thoughts that we have. The idea is there but the words are not.

Words are labels for ideas. They have no meaning in themselves, but are given meaning by the user and the hearer. (Sometimes these two meanings are not the same thing at all.) The word does not come into being until after the idea it represents is fully developed. Early man did not sit down to invent something to fit the word "wheel". Certainly the idea that round things move more easily than square things was recognized long before the invention of the device. The word became necessary only as a means of communicating the idea to someone else.

In young children language develops in much the same way. The child has the idea of who and what mother is long before he understands or can use the word.

Gradually, the child will come to understand the written symbol for the word mother, but the written symbol represents the word and not the idea of mother.

This progression from idea, to word and then symbol is not the way it happens in math. Children learn to recite the number names and may even learn the written symbol which represents that name long before they have a clear idea of what the number represents. This gives us the impression that they understand when they really do not. At the same time, much intuitive understanding is developing for which the child has no labels because, not having developed a clear understanding of the labels which he has, he is not able to apply them meaningfully to the new ideas he develops. That this intuitive learning actually takes place is evident in the fact that children with severe language problems are able to work out complex mathematical concepts using physical objects.

However, the teaching of math seldom begins at the intuitive level. We begin with the assumption that the words have meaning and go on to teach math verbally. Even when physical objects are used and the child is given time to manipulate and discover, it is assumed that by simply giving him the proper label (add, subtract, equal, etc.) the meaning is clear and useful. The phrase 2 + 2 = 4 has an entirely different meaning for the teacher who says it than for the child who hears it.

When the child does perceive his lack of understanding and asks questions, too often our answers once more assume understanding and are couched in words which do not clarify, but only add to the confusion to the point where the child ceases to ask.

What, then, to do? If knowledge is, as Piaget suggests, a construction rather than a copy of reality, then we need to give children time to construct the knowledge and then to construct the language with which to express this knowledge. In aiding that construction, we need to be certain that we understand the child's present language, use the language he understands in teaching, and don't take what he says at face value. Question and probe to find out what meaning he attaches to the words he uses. Are these real expressions of understanding or simply recitation of phrases he has heard and found it convenient to repeat in much the same way that he learned to recite 1, 2, 3, 4, 5, 6?

Give him reason and opportunity to practice the development of language. He cannot do this by listening to the teacher, by working endless pages of problems, or by working alone. He needs to talk to someone in order to learn how to talk. Kenneth Lovell in his article on "Implications of Piagetian Research for Education" for the Teachers' Center, points out that working in small groups forces the child to put his learning into words that are his own and not the teacher's. If language developed in the beginning as a means of communicating ideas to others, it will develop in children for the same reason once the need arises.

Language is the way we communicate. If a child has not the language to express his math concepts, how is he to let others know what he understands?

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Human Scoreboards

Vicky Schaefer

Each day I begin my math class with a group activity, my favorite of which is adding a series of numbers mentally. We display our answers by using our hands--the right hand being the one's digits and the left hand being the ten's. One day the total scored fifty-six. Quickly the class decided a buddy system was needed. Our human calculators are now able to score into the hundreds. The children have begun to understand both place value and team effort.

KINDERGARTEN TOY CLASSIFICATION

JoAnn Langham

Keeping toys organized in a kindergarten room is a real problem. But one can enlist the children's help, as I did recently.

I prepared a box. On one end, I affixed a label which contained a picture (from a magazine) of Lego blocks and the words LEGO BLOCKS. I showed the box to the children and suggested that they sort the toys so that people can easily find and return things as they play. Empty boxes, magazines and old toy catalogs were made available.

The children sorted the toys and then 3-4 children prepared the box for a particular classification. My class used the following categories:

lego blocks
puzzles
banks
kitchen
stuffed animals
blocks
small cars & trucks
animals
pots 'n pans
sewing
people
large cars & trucks
dolls

The children took pride in their work. They learned a lot about classification and the play area is neater. A real world problem was solved.

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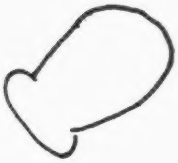

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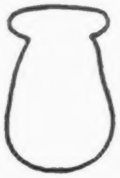

PRACTICAL TIPS ON THE 4TH R, ART!

Kathy Holzhauer

Many elementary teachers feel they cannot have art in the classroom because (a) it isn't that important and they don't have time, (b) they're not talented and it's too messy, (c) they have an art specialist (the children are fortunate).

It is the purpose of this article to convince teachers that art is vital to the overall education of children, to help teachers to realize that the art concepts are too important to limit to a once a week art period and should be integrated into other subject areas, and to give teachers practical tips for doing so in your classroom.

Ours is a highly technological and changing world that children must learn to deal with. We must not limit education to the development of a few skills when it is obvious that people use combinations of skills, knowledge, and feelings to come to terms with their world. Education should not limit itself to those bits of knowledge that are easy-to-teach and easy-to-test. It must go beyond mere training to do routine tasks, and help the student to apply his knowledge and skills, to reason about his society, and to make informed judgments.

Art education plays an important role in this development. Besides benefitting students with the most obvious, artistic knowledge and skills, it also allows for development of creative thinking and problem solving. Art makes available a wide variety of materials that children can work with instantly, allowing for the use of the mind and the hands and eyes. It is a subject area with no right or wrong answers which allows for the development of new and original approaches to solving problems. Art education increases abilities in judgment and valuing skills, awareness of the world and themselves, and communication skills, not to mention the pleasure of creativity which allows children these benefits in an enjoyable way. Art is essential to a civilized society, and to children in a civilized society.

Most of you are not mathematicians, scientists, sociologists, etc., yet you do not let that stop you from teaching these subjects. For some odd reason, many people view art as an area where either you have it or you don't. Art is not a matter of talent, but rather of practice. This goes for children's art too. (This is especially important for older children to realize.)

Adults seem to think that children's art work should look like that of an adult. What a silly view! Children are not expected to read encyclopedias in first grade. The fact is that children produce exciting, spontaneous art work that no adult can imitate. Children are unique and creative individuals. Their way of seeing things is exciting and original.

Teachers are often surprised by children's very logical reasons for representing things the way they do. When you know this, you come to value their work for what it is. You begin to realize that a row of identical snowmen is not visually exciting. Further, it should be noted that the measure of a good art activity is not necessarily the finished product, but rather the value of the creative experience.

A valid art activity is not a project reduced to a series of patterns. It is one that allows the children choices (choice of subject, color, shape, etc.) so their individual creativity can be developed. When allowing children a choice of subject, don't just tell them to do whatever they like. Rather suggest a large framework to give them ideas (zoo animals, pets, occupations, transportation, environments, etc.).

Children in K-3 do spontaneous and uninhibited art. They should be encouraged to "draw big" and fill the paper. Encourage them to break things down into basic shapes when they don't know how to draw something. (Child: "How do you draw a giraffe?" Teacher: "Think about the shapes. What's a good shape for a head?" Child: Circle." [If he says "triangle," that's great.] Teacher: "What about the body?" Child: "Rectangle." Teacher: "And the neck?" Child: Rectangle." Teacher: Legs?" Child: Rectangle." Teacher: "Long, skinny ones." Aha! You have a giraffe. [Great to let the children cut construction paper and glue pieces onto a large sheet. The whole class can create a jungle mural.])

As children reach fourth grade, many begin to realize that what they are drawing does not look realistic. It is important for them to understand that we learn to draw by doing it. Encourage them to really look at things to see what they are like. (And to look in encyclopedias for pictures when drawing something.) Encourage them to look for basic shapes and break things down so that things don't seem so overwhelming.

Do not do the work for them. Children learn by doing. When they become frustrated and say that I can draw better, I tell them I've had lots of practice. That is what they need. If I do it for them, the experience is mine, not theirs. Don't do a drawing on the board for them to copy. Children must learn to solve their own visual problems and not just copy the answer to an already solved problem. To start with a finished product can block creativity and make the whole activity trivial. Children can so easily be programmed to look for what the teacher considers correct.

Construction projects are great problem activities for kids. Much construction can be done with (what else?) construction paper. How about a construction paper scrap box in your room? It's invaluable. It saves paper and it saves time spent cutting little pieces of this color and that for various parts of a project. (You know how the instructions read. Straight from the book: Materials for penguin puppet: 1. 1 9"x12" black construction paper; 2. 2 3"x4" white; 3. 1 1"x3" orange; 4. 2 3"x3" orange; 5. 2 3"x6" black. This would take forever to cut and the creativity would be gone.) Instead, take the basic idea. Talk about animals, for example, and let kids choose one 9"x12" sheet from various colors for the basic body piece. Work together on this. Talk about what else animals have (eyes, nose, mouth, tail, etc.). Let children choose a 6"x9" paper to cut up for whatever they want. For other colors, they use the scrap box. They are quite capable of cutting their own shapes. The pieces may not be perfectly shaped, but will have a human touch and will not look mechanical. Kids will also have learned more about shapes and how to make them. This is much richer for the children and much easier for you. Few projects I've seen cannot be handled this way. Feed the scrap box with large leftover scraps from projects, faded paper off bulletin board (one side is good), and whatever else looks interesting.

Some other neat materials you might want to have:

odds and ends of cardboard

yarn scraps--to weave, glue, they have lots of ideas of what they want to do with it

egg cartons--paint trays you just throw away

polytemps--tempera cakes, great for painting with younger kids
(less mess, more control)

nylon bristle brushes--use with tempera, kids have more control,
wash easily, keep shape longer

watercolor sets--replacement trays can be ordered for container
and also individual colors (cheaper)

colored chalk

sponges--great to wash a lot of not so dirty hands quickly, cleans
tables better and with less waste than paper towels
(Caution: you should wet and squeeze out sponges. Kids
fill them full and squeeze out all the water in room.)

rubber gloves--you use these when washing brushes, etc.,
avoids embarrassing green hands in public.

It is important to develop a life style for your room that will accommodate art projects. This is not so much a change in the room, but a change in state of mind (not only yours, but the kids). We have a few basic rules. We view the room as an ever-changing environment with a life-style of its own. We respect the work and materials in this environment (I really stress this). And we keep our eyes open to what is happening in the room. Wet paintings may be on the floor where yesterday it was clear. (Visual reminders can help children. We have orange cylinders (cardboard painted) and a Stop sign we put out to warn students as they move around the room.)

As they work together often, children develop certain patterns of work and clean-up and which allows us to get to the heart of the project without a lot of explaining. But this does not mean we are locked into a routine. When a situation calls for a different approach, we are open to it.

During the work we allow for necessary disarray and keep an open mind. Many times this is necessary for a project. We can stand the mess if we know the end result will reward it. (Insight into an art teacher: No, I don't like mess, but I love the results. It's worth it.) Children are responsible for clean-up. It is important that they learn what an activity requires in clean-up and it is important that responsibility be gained by people cleaning up after themselves. (For the very young children, I wash brushes and take care of major things, but they are responsible for getting the room back in order and getting things put away.) Sometimes getting children to organize materials seems to take longer than doing it yourself, but the kids learn from what they do and that's the payoff.

Work with your room's limitations. Brainstorm for new ideas to expand past those limitations. The more you do an activity, the smoother it goes.

As children work in this situation, they become better able to handle the materials and the choices. Start out with fewer choices and materials so as not to overwhelm them or you. Increase choices and materials as kids become more comfortable. Alternate big projects with easier ones. What may seem old and simple to you may be new and a valuable experience for the children.

Art experiences can be valuable in aiding students in other subjects. Studies show that schools which introduced art into the curriculum had marked improvements in math, reading, and science. The benefits of art flow to other subjects areas. In all subject areas teachers can arrange activities that allow students to think creatively, to solve problems, and to use various materials. Don't ditto everything. Let the students draw their own. This increases their observation skills. In all subject areas, encourage children to construct models. As you use art more in you room, more ideas will come. The kids will give you a lot of ideas. I've learned a great many good things from children I would never have thought of.

Your students will value what you value. Our future depends upon our creativity. As physical resources become less plentiful, we must encourage human resources, our creative selves, and the budding creativity of children.

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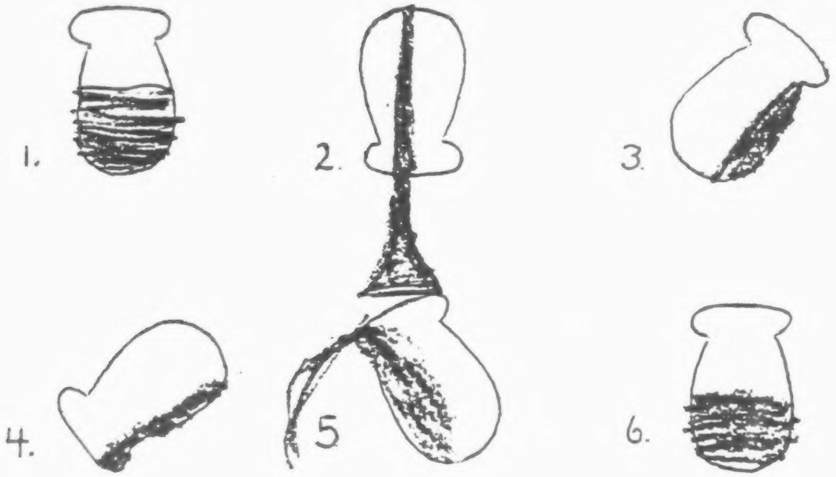


WHAT IS THE LARGEST NUMBER?

Helen L. Miller

Parent: "My child can count to one hundred. I know he will do well in school. After all, he knows all his numbers!"

Johnny: "1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,..........100."

Parent: "Tell the teacher how old you are."

Johnny: "Five."

Parent: "Now tell the teacher your address."

Johnny: "1202 Main Street . . . 876-1002."

Parent: "We have been helping him at home!"

What more can a teacher ask for--a child who knows all his numbers and a parent who is conscientious and willing to work with his child at home!

But wait! Is this a child who has done an excellent job of copying names and labels, or is this a child who has organized and made sense of things?

Is this a child who has a schema on which to draw when necessary, or is this a child who has simply been copying what adults have repeated a million times?

How can a teacher determine the child's true concept of numbers? How can we be sure that a child in the pre-operational stage of development really understands numerousness and the function of numbers?

The idea that numbers are a means of conveying information and that one number can indicate something specific, such as how many cookies we need in order for all the children to have one at snack time, are very difficult ones for many children to grasp. The ability to use numbers to express a quantity has no correlation to reciting the numbers from one to one hundred.

If one has all the parts needed to make an automobile, but has had no training in the mechanics of how those parts go together, it would be very difficult to make a workable vehicle.

If one knows all the words needed to speak Chinese, but does not know what those words mean, it would be very difficult to speak Chinese.

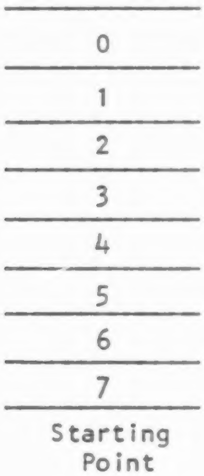
In many ways, I feel that children understand number as well as I understand Chinese!

As a kindergarten teacher aware of this discrepancy between rote learning and internalized understanding of numbers, I have used every conceivable opportunity throughout the school year to help the children develop a thorough understanding of what numbers mean, their relationships, and how they convey information.

We have counted cookies, cups, each other, and anything else in the room. We have used blocks to visually describe the number of items counted. We have made graphs in order to compare the numbers of items counted. We have used peg boards to indicate addition and subtraction facts. We have had stories about numbers. We have measured everything that did not move (as well as some that did) to illustrate how numbers are used. We have compared the weights of things and discovered that heavier things made the scale move to a larger number. I would have staked my reputation on the fact that the children in both my classes had mastered the concept of numerality.

In order to verify the faith I had in their ability, I decided to have the entire class play a number game using bean bags.

The game board was the floor of the classroom on which I put down masking tape in the following manner:



Each child was given a bean bag. The game proceeded in the following way:

1. Each child took a turn, standing with his toes on the first stripe of masking tape.

2. Each child had to indicate first which one of the numbers on the game board was the largest.

3. He then threw his bean bag to that number. (The object of the game was to get as many points as he possibly could.)

The fifteen children who participated in this game were very familiar with the numbers before we started the game. I verified the number they said by having each of them walk over and stand on the number they said was the largest. We also reviewed what was meant by the term "largest".

The following figures show how the children performed this task:

1. Four children chose seven as the largest number

2. None chose six

3. Four children chose five

4. None chose four

5. Two chose three

6. One chose two

7. Two chose one, and

8. Two chose zero which was the number the farthest distance from the child.

The conclusions that I drew from this exercise, or rather the questions that came to mind, are:

1. Does distance relate to a child's concept of number?
2. Did most of the children understand that zero indicated a quantity?
3. Is five the largest number that some of the children can relate a specific quantity to; that is, they can conceive of five meaning five concrete entities, but anything beyond five is simply a thing one says?
4. Do children confuse the numbers three and five, or is three really the largest number to which they can relate?

This game can be played with older children using larger numbers. I would like to hear about the results others obtain using this game. There are definitely many questions yet to be answered about how children perceive numbers.

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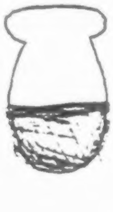

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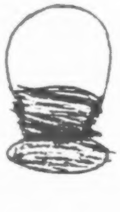

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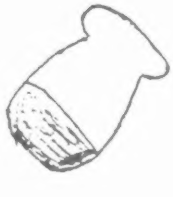

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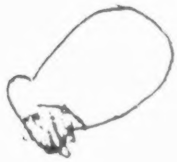

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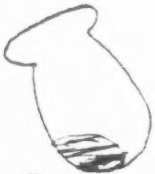

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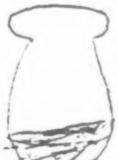

COUNTING BACKWARDS TO SUBTRACT

Anne Betscher

It has long seemed curious to me that so many primary and early intermediate children subtract by counting backwards the designated number to find the answer or count backwards to the designated number then count their counters to find the answer. An experiment I recently conducted with a four year old child gave me some insight as to why children might subtract in this fashion.

The experiment is as follows. I asked the child to count out five pennies. I then checked to see if she knew how many pennies were in the group. She did. I covered two pennies while her eyes were closed and then asked her to tell me how many were under my hand. She counted the three showing and then said, "two more." When I later raised the number of pennies in the whole group to seven, she could not tell me how many were hidden. But within her limits, she could deal with the idea of adding more objects to one group to comprise a larger, superordinate group.

Now, to relate this to the counting backwards phenomenon. It seems that if a child is taught subtraction before he or she can adequately deal with the idea of adding more to reach a sum the child might adopt the counting backwards method. In fact, many children are actually taught the counting backwards formula by learning to subtract using a number line system. (That is: count up to 7, count back 3 units, arriving at the answer, 4.)

To understand (or be able to use) the counting backwards method a child must only know the order of numbers. On the other hand, to understand that four more objects are needed to make a set of three objects into a set of seven objects requires a deeper level of thinking.

Even when a child becomes able to deal with the concept of combining sets to make a superordinate set he may, for a time, rely on the system he initially learned for dealing with subtraction. Thus, this counting backwards formula may continue to be used until problems are presented in which the process is too difficult, or until the use of the formula produces too many errors, or until the user decides that a more efficient means for solving the problem is available.

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TAXMAN

Ed Graves

This summer Tom O'Brien introduced a game called "Taxman." The students are given the task of making 50 squares or circles numbered from 1-50. They are then arranged in order (1,2,3,4,...). Each player tries to beat the Taxman. The player picks a number and keeps that number, but taxman gets all the factors of the number. Then the player picks another number. For example, the taxpayer picks 30, the taxman gets 1, 2, 3, 5, 6, 10, 15. (Is this a good pick if the range of numbers was 1-30?) After all numbers have been picked that have factors, the remaining numbers then go to the Taxman. Hint: Start with a small set of numbers such as 15 and work up to 50. Try the game with 100. (This game is part of a bank of educational computerized games available through the Minnesota Educational Computer Consortium.)

NUMBER RELATIONSHIPS

Norma Whited

Promoting interest in number relationships can be encouraged through class experimentation. When filling in a multiplication chart a group of third grade children found the following relationships:

Numbers up to 12 multiplied by numbers up to 12

(a) 1 2 3 4 5 6 7 8 9 10 11 12

(b) 2 4 6 8 10 12 14 16 18 20 22 24

(c) 3 Add rows (a) and (b)

(d) 4 Twice row (b)

(e) 5 Add rows (a) and (d)

(f) 6 Twice rows (c) or three times row (b)

(g) 7 Add rows (a) and (f)

(h) 8 Double twice row (b) or twice row (d)

(i) 9 Three times row (c)

(j) 10 Twice row (e)

(k) 11 Add rows (a) and (j)

(l) 12 Twice row (f) or six times row (b)
Three times row (d) or four times row (c)

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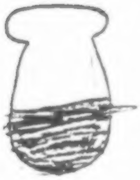

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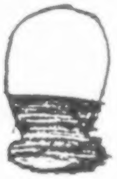

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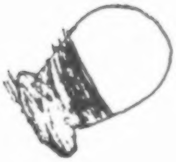

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ASSIMILATION/ACCOMMODATION

Helen L. Miller

Professor Franz-Stephan Morgenstern in his lecture on Monday, January 11th, at SIUE, described the socially maladjusted child as a child who is unable to assimilate the concepts necessary to learning. The socially maladjusted child merely accommodates, that is, he copies without taking into his internal structure what he needs to know to be motivated to achieve.

There is external learning that is purely superficial. There is no schema developed upon which the child can rely or draw upon in future situations. The child is, therefore, handicapped because he has not internalized learning. He is not able to enjoy the rewards of knowing that he has achieved a particular skill and feels no sense of motivation to learn.

I feel that in some respects schools today are not only not addressing the needs of the socially maladjusted child, but are in fact encouraging children to become socially maladjusted.

How often do very "normal" children in some of our school situations learn to accommodate, without any assimilation taking place? They are merely copying without truly understanding--they are unable to use the information and are unable to apply the concepts they have "learned." They duplicate; they replicate, but they cannot utilize what they have been "taught."

Is this a wild accusation without substantial evidence to verify that such a problem exists? When the drug problem and alcoholism is a great concern in the elementary schools, as well as in the high schools, I ask myself if these are children who are socially well-adjusted. Are these children children who have a good self-concept? Are these children able to utilize the things they have learned in school? Are these children motivated to achieve in school? Or are these the children who have learned facts without meaning or concern?

When one of the schools in the district is vandalized for no apparent reason, except one of sheer aggression and hatred, I am extremely concerned about what we are doing in the classroom.

We excuse this kind of thing by saying that this is indicative of a sick society. But why is society sick? Is it the fault of unconcerned parents too busy making a living to tend to their families? Parents have always been busy making a living. Is it because teachers do not do their jobs? Teachers are as concerned about children as they ever were. Could it be that we need to reevaulate what we are doing in school where children spend a great portion of their day?

Is it not time to listen to what these children who are telling us very loudly and clearly that it is not the basic facts that they need, but concerned educators who will facilitate learning in a way that is meaningful to them? They need to assimilate before they can go on to accommodate more information; they need to succeed; they need to know the feeling of accomplishment which brings motivation to learn. Is it not time to emphasize the importance of the child and not his test score posted in the teachers' lounge for all to see?

As people concerned about children, let's help students adjust to a rapidly changing world. Let's do everything humanly possible to help children become socially adjusted. Let's strive to make each child know his own worth and help him to develop his capabilities to the highest level possible. . . . Then, and only then, can we consider ourselves educators!

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ROLL THEM BONES

Helen L. Miller

Materials: One die for each player. (Each one is a different color. These are available from any carnival supply store at a very nominal cost.)

One pencil for each player

One piece of paper for each player

Play: Each player rolls his die. If any of the dice match, each of the players who has a match receives one point. The dice are rolled until any of the players receives a total of 10 points.

This is a very simple game which small children enjoy playing very much. When they put down their score they are to make a tally mark. To find their total score they must count the tally marks.

This game is easily made more difficult by requiring the players to have a total of five to be able to get a point. Or any two dice that give a prime number when counted together will give the players who rolled them a point.

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PRIME FACTORIZATION

Joyce Goodall

Ask five or six children to make up two decks of cards:

Composites (White)	24,30,36,40,42,48,54,60,66,70,72,84,90, 105,120,126,132,140,144,150 (20 cards in all)
Primes (Green)	nineteen 2's, twelve 3's, five 5's, three 7's, and one 11 (40 cards in all)

Place 4 composite number cards (white cards) face up and set the remaining white cards aside.

Shuffle and deal 6 prime card number cards (green cards) to each player and place the rest face down in the center of the table.

The player to the left of the dealer begins by playing a prime number which is a factor of one of the composite numbers. If he does not have such a card, he draws from the prime number pile but may not use the number he draws until his last turn.

A player who completes the prime factorization of a composite number picks up the number and its factors and places them in front of him to be counted at the end of the hand.

The game is over when the four composite numbers are gone or when any one player has no more prime number cards.

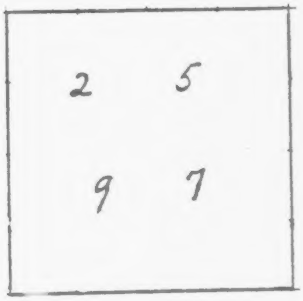
To score you add 5 points for each composite number card (white) and 1 point for each prime number card (green). The player with the highest score wins.

To play another hand, choose 4 more composite number cards and shuffle and redeal the prime number cards.

I learned this game, creator unknown, while attending the National Council of Mathematics Teachers' Convention in St. Louis.

MORE FROM STARTING POINTS

Fractions

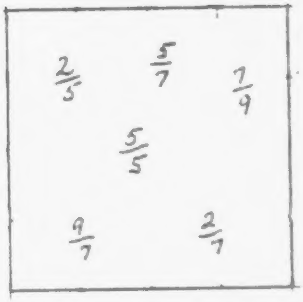


Write a fraction using any two of the numbers.

Write another fraction, another, another,...

A question may arise about using the same number twice. If it doesn't. . . .

What fractions can you make using the same number twice?



How many fractions can you make?

How many different fractions can you make?

Depending on which four numbers are chosen in the first instance the number of different fractions for any four numbers will be: 13, 11, 9, 7, 5, 3, or 1.

$\frac{2}{2}$	$\frac{5}{2}$	$\frac{7}{2}$	$\frac{9}{2}$
$\frac{2}{5}$	$\frac{5}{5}$	$\frac{7}{5}$	$\frac{9}{5}$
$\frac{2}{7}$	$\frac{5}{7}$	$\frac{7}{7}$	$\frac{9}{7}$
$\frac{2}{9}$	$\frac{5}{9}$	$\frac{7}{9}$	$\frac{9}{9}$

Arrange all the fractions in some form of table.

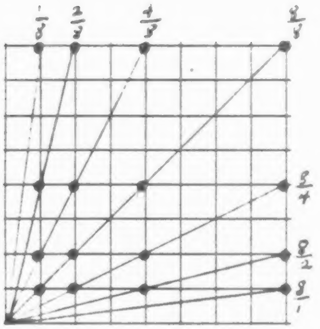
Several different forms of tabulating are likely to emerge and each will highlight some property of the set of fractions.

Which is the smallest fraction? The largest?
Which fractions are less than 1? Greater than 1? Equal to 1?
Which fractions are equivalent?
Write the fractions in order of size.

Investigate numbers of fractions for other sets of four numbers.

$\frac{1}{1}$	$\frac{1}{2}$	$\frac{1}{4}$	$\frac{1}{8}$
$\frac{2}{1}$	$\frac{2}{2}$	$\frac{2}{4}$	$\frac{2}{8}$
$\frac{4}{1}$	$\frac{4}{2}$	$\frac{4}{4}$	$\frac{4}{8}$
$\frac{8}{1}$	$\frac{8}{2}$	$\frac{8}{4}$	$\frac{8}{8}$

Consider the four numbers 1, 2, 4, 8. How many different fractions? Equivalent fractions? Fractions greater than 1? Less than 1? Equal to 1? . . . Which pairs of fractions have a product equal to 1? How many pairs of fractions are there like this? Is it possible to decide on the number of different fractions for any 'n' numbers?



As the fractions have been derived from taking number pairs they can be plotted on a square grid or lattice. In this way the equivalence is seen as sets of points on straight lines.

The activity starts with four numbers and fractions are made out of these. We might generate other numbers with other operations, $a * b$ for various $*$ (e.g., subtraction).

Banwell, C. S., Saunders, K. D., and Tahta, D. G., Starting Points. London: Oxford University Press, 1972.

A CHRISTMAS CARD FROM THE NETHERLANDS

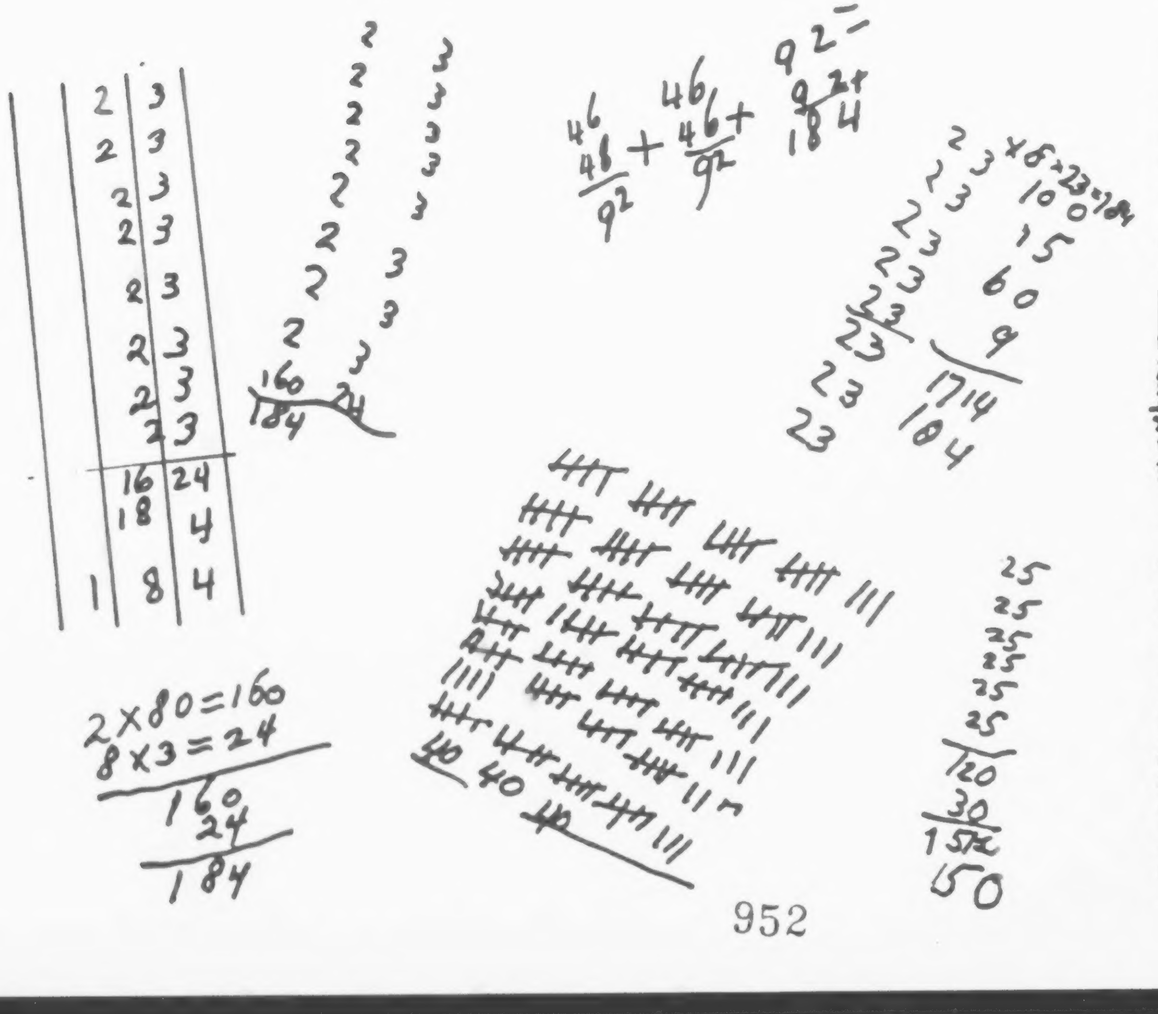
On these two pages we reprint verbatim a recent note from Prof. dr. Hans Freudenthal's Vakgroep OW&OC in Utrecht. Provocative???

Santa Claus has 8 sacks, each filled with 23 presents. How many presents is that altogether?

Christiaan (8 years old) solved it like this:

20, 40, 60, 80, 100, 120, 140, 160, 163, 166, 169, 172
175, 178, 181, 184, CHRISTIAAN.

First he adds together eight twenties and then eight threes, counting as he goes.
But just take a look at the interesting didactic puzzles presented by Christiaan's classmates on the inside of this card. And also at the investigative questions on the back!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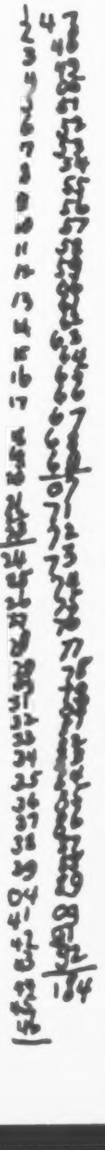

RESEARCH IN MATHEMATICS

Research in Mathematics Education

On this card you will find nine different solutions to one problem. The solutions have been chosen from the answers of thirteen third-graders.
Have you figured out the various methods of reasoning?
Sometimes tedious figuring and clever shortcuts are used alternately in one solution.
Are you too in the dark about 2 x 80? And how do you get 6 x 25 from 8 x 23?
These pupils have a good command of the multiplication tables, yet do not, or hardly ever, make use of them.
Why is that?
Could third-graders come up with even more solutions?
Turn that over in your mind, or try it out in the classroom.
We've posed ourselves two questions:

- More than half the time intended for arithmetic in elementary schools is usually taken up by multiplication and long division practice. Is this worth the effort, considering the availability of adding machines and computers?
- In other words: isn't too much time being spent on pencil-and-paper arithmetic and too little on mental and applied arithmetic?

These are a few of our research tasks for the year 1982. Will you think along with us? Then send us your reactions to the above questions! We will print a summary of them in 'De Nieuwe Wiskrant'.

Vakgroep OW & OC, Tiberdreef 4, 3561 GG Utrecht, The Netherlands

"CUTTINGS"

Teachers who come to the Teachers' Centers turn in a weekly diary. In it they've written what they've been reading, activities they've tried with kids and their observations of children's thinking along with general comments they wish to make about what they've been thinking, reading, doing and observing.

Many of these diaries contain material that is too good to remain buried in someone's file; it begs to be shared. So, in "Cuttings" we've simply lifted parts of individual diaries and reprinted them. Read them, think about them, share them, help them grow.

Julia Hodges

I had never given much thought to the possibility that praise could be doing just the opposite of what was intended. Handing out jellybeans has never met with my approval but I have certainly used such comments as, "Steve, that is excellent," or "Mary, I'm so proud of your work!" Martin points out through research that praise gets in the way of learning. I have also seen high praise result in over-confidence--that is especially true in sports. I will also agree that students will sometimes tease or mock kids who have been praised. This can be due to jealousy, a feeling of superiority, etc. Lawlor concluded in his research that praise has a different effect on girls than it does on boys. Girls are more susceptible to praise but this has not been definitely proven. I especially liked the idea of taping your conversations with students to see if you are praising too much. Also, which students seem to be receiving most of the praise. If praise does seem to be a main problem in the classroom, learn to slow down. Be silent more often. Let the students learn to set their own goals and determine their own tasks. Talk casually and privately with the reluctant student. Usually this student has been afraid of speaking out in class and has not had a chance to share his opinions. Private conversation will do more to build confidence than open praise in the classroom. I found his last suggestion rather amusing. He stated, "If you manage to stop praising students and then find that the urge to praise is building up inside you and that you absolutely must relieve the pressure by praising someone, lay it on your colleagues. Overt, heavy, person-oriented praise has not yet been found to have deleterious effects on teachers."

JoAnn Langham

I do question what I do in the classroom. We can never go back and hindsight sometimes shows us our mistakes. I get very frustrated trying to accomplish everything I'm "supposed" to get done. I want kids to experience life, take time to investigate and probe and question and work out. Hopefully, I'm taking more time to do those things. Slowly I'm doing what I now believe and have always believed to be the way to teach but I still feel the pressure to be getting the paper work covered. I have found many more days when school is over we have papers we didn't use but we got involved with what we were "doing" and learned and remembered more the next day.

Judy Harnetiaux

OBSERVATIONS: See how people count. I worked with two fifth graders, one fourth grader and a teacher. (He felt put upon and was on the defensive but later explained he was very good in math and that is why he worked for me.)

The first fifth grader counted out 21 quarters one-by-one and when I said I meant 17 she just pulled four away from what she had counted. The other fifth grader counted out 21 quarters.by twos and when I said I meant 17 he pulled out four, stopped, said he lost track and started at one again.

The fourth grader counted out eleven one-by-one very carefully; when I said I meant seven he pulled four away from his pile and then recounted the pile. This was one motion for him. It seemed very natural for him to immediately recount the pile.

With these children their first reaction to what they thought was my mistake was to subtract. I believe they so readily use subtraction because they are tuned in to school and associate math and school.

The defensive teacher counted out the quarters by two's and when I said I meant another number, he quickly pulled the extra away by subtraction. He grinned at me and asked what I was trying to find.

Barb Tally

The Teaching of Young Children (Molly Brearley, ed.)

Where do I begin--it's almost impossible to react to this book in a short paragraph or two. I must begin by admitting that this reading sharpened my understanding of Piaget's theories--more than ever, I am fascinated with Piaget's knowledge of children (their thinking, their learning, their behavior--everything about them). The way this book is written not only sheds light on Piaget's work, it also encourages one to further explore Piaget and children. The countless examples make this truly rich and interesting reading--the authors draw on their own experiences with children as well as Piaget's.

There is one particular group I would really recommend to read this book, and that is college students just beginning in the field of education. One reason is, of course, the study of Piaget. The other (probably the more important reason) is that over and over in this book the crucial role of the teacher is emphasized. It is not an easy job!!! Teachers not only have to have some (?) knowledge of the subject(s) they will "teach"-- they play such an important role in the children's growth (intellectual, emotional and moral). They not only have to know children, they must know each individual child. Teachers are not only models for children, they are active molders of children. And I could go on and on--teaching is very important (sometimes discouraging and yet so very rewarding). This book really brings all this to light--maybe reading it could encourage the less "dedicated" to get out and the more "dedicated" to work harder at becoming good teachers! (I should add that it is super reading for anyone interested in children and their learning.)

TRYOUTS OF ACTIVITIES AND OBSERVATION OF CHILDREN'S THINKING

We (my 3½ year old son and I) have been working on the counting exercise talked about in the last class session. I first had Brandon count out 5 pennies from a pile--when I only needed 4, he immediately put back 1--then counted 1-2-3-4. We returned these four back to the pile. Then I had him count out 10 pennies from the pile--when I only wanted 5--he put 4 back--then counted 1-2-3-4-5-6--oh, put 1 more back in pile and counted 1-2-3-4-5. We continued on with these 5--I told him I wanted 7--he added 2 and counted 1-2-3-4-5-6-7. It appears (as in first tryout) he knew to take away the one (5-1=4 or 5-4=1), but had to then count to make sure. In every instance (and we did several more) he would immediately add to or take away from and then would count to check himself. If he did make an error (as in example 2), he would correct it after counting and then re-count to make sure. Never once did he completely start over, in working with up to 10 pennies. I must admit I was surprised; I had assumed he would, especially when working with over 5.

While we had the pennies out, I decided to work with the concepts of more than and less than. I put 3 pennies in one pile and 5 in another (all visible). Which has more? Again, he counted. (I must note that at first he counted the sum of both piles (8)--I then explained to count 1 pile, then the other. This is something he repeated each time we did this activity.) The pile with 5 has more because "5 is bigger than 3". We did this a couple more times with similar results. I then tried putting the pennies in rows, assuming he'd choose the longer row as more. Never assume anything with children!! Brandon again counted all the pennies first (both rows), then counted each row and told me which had more because its number was "bigger". The same with less--its number was smaller.

I would also like to mention that while doing these activities I noticed Brandon counting on his fingers on both hands, something I had never seen him do before. And something else interesting I've noted these past two weeks--eleven is now one-teen, twelve is two-teen and so on. Learning is fascinating--both for the learner and the observer!

Brad Huber

Readings: Bruner, Jerome S., The Relevance of Education. Activity: From sub-topic "Using One's Own Head" in Chapter entitled "Some Elements of Discovery."

Bruner argues that children already have many more useful models in their heads than we are aware of or are willing to try to use. We have to convince children or "exemplify for them" the fact that there are useful models in their heads.

Using the following puzzle I tried to determine if children could recognize if language could be reduced into what Bruner called type and order.

THE	MAN	ATE	HIS	LUNCH
A	BOY	STOLE	A	BIKE
THE	DOG	CHASED	MY	CAT
MY	FATHER	SKIDDED	THE	CAR
A	WIND	BLEW	HIS	HAT

At this point the children were asked to read the sentence and tell me what they saw. The first child said she could read not only "The man ate his lunch," but also, "The boy chased the hat." The next child decided that you could choose any word from any column and it would make a sentence. Two very structured "gifted" children maintained that some of the sentences were nonsensical (my word) and therefore could not be considered sentences.

Asked to make their own to fit the puzzle, they produced the following:

1. The girl kissed her mother.
2. The animal liked its paw.
3. The person blew a horn.
4. The pitcher threw the ball.

To determine if they would use the models in their heads, I asked the following three questions:

1) What kinds of words fit into each column?
2) Could new columns be added to the puzzle?
3) Could the order of the sentence be changed?

In response to the kinds of words in each column, the children quickly pointed out column 2 contained nouns and column 3 contained verbs. Someone pointed out that column 5 had more nouns. Columns 1 and 4 gave a little more trouble until someone remembered that nouns follow those kinds of words so they called columns 1 and 4 noun markers, the term used in their language books to classify these words.

The response to the third question was that the order could not be changed and still have the sentences make any sense.

The response to the second question was more interesting because the children insisted on trying to add the new column at the end. After a few hints we finally added a "zero" column using the words did, has, and can.

The children generally agreed that order determines meaning and that certain types of words are necessary to make a sentence.

This exercise provided plenty of opportunity for children to use existing models and a good bend might be to introduce new types of language into an already existing puzzle or model. If they can use their model to determine the known, then by determining the known, they should be able to recognize or isolate the unknown.

Margaret Read

I was able to try the transitivity of length experiment with two of my three. The first had a problem figuring out how to use the string I gave him to compare the lengths of the first two sticks. He laid it down so that the ends of the string extended beyond the ends of the stick and discovered that the string was longer than the first stick. Then he laid it down next to the second stick and discovered that it was longer than that stick too. He was baffled for a few moments as to what to do next. Finally he placed his fingers on the string where the ends of the stick had come and moved the string back to the first stick. By this method he discovered that stick B was longer. In measuring stick B and C, he had no difficulty in doing the measuring and told me immediately that C was longest of all. When I asked how he knew, he scooped up all three sticks (I had them laying on three different tables) and laid them down side by side to show me. When I said, "But that isn't how you found out," he would not be persuaded to explain what he had done. Anyone could tell C was longer and that was that. End of question.

The second boy had no difficulty in using the string. He placed one end of it at the end of the first stick, held the point where the other end of the stick came between his fingers and transferred the string to the other stick. I asked, "Why did you do that?" He explained that the string showed how long the stick was and when you laid it next to something that wasn't the same size it would show you which was longer. He quickly did the same thing with the remaining pair, concluded that C was longer and said, "B is longer than A and if C is longer than B it has to be the longest one." He did not find it necessary at all to get them together to find out for sure. His measuring was quite enough. I asked if he had measured things this way before. He said, "No, but I think it would work any time you wanted to know if something is longer than something else. If you wanted to know how long it was, it wouldn't work, though." When I asked if he ever needed to know how long things were he said, "Sometimes when I help my dad he lets me measure things for him just for fun." This boy has had experience. He was the only one in my class who did all of the conservation activities for me successfully a couple of weeks ago.

Anne Betscher

At the end of health today Kelly said to me as she lined up, "Your heart beat is infinity, for you?" We hadn't discussed infinity for two days so I knew that Kelly had been working with the concept on her own.

I felt as if I had "stretched" her mind a bit by introducing and discussing the concept. "Wow, her mind may be growing!" I said to myself.

Later in the day she found a picture of a volcano taken from the air such that the crest of the volcano was above the cloud cover. We have discussed volcanoes. Kelly wanted to know if when the volcano erupted would the lava flow on top of the clouds. I was taken by surprise. I tried to remain calm. "Do you know what clouds are like?" I asked. "Well, they're white and fluffy and have water in them," she replied. "Do planes go through clouds?" "I guess." "On TV people can sit on clouds. Sometimes angels walk on clouds."

I then tried to explain to her that clouds were like thick fog but just up in the air. You can go through fog even though you might not be able to see through it, etc. I continued by saying that a lot of things on TV were make believe and couldn't really happen. I'm not at all sure I convinced her.

Later I asked her if I could bring up the question in class. She agreed. I was shocked by the number of kids who shared Kelly's ideas about walking on clouds. I think the discussion (with others who knew otherwise) in class jarred many of their mental reality images of clouds. Perhaps this accommodation will help them evaluate TV presentations a bit more critically.

TV! Think how confusing it is to a child forming ideas about relationships in reality!

As I read through Sigel's interpretation of Piaget's ideas on the transformation from egocentricism to decentration I was reminded of a personal experience in which I grew over time from one view to the other.

In about the third grade I had a friend who lived in an enormous house. Her older brothers and sisters all lived away so the big house was our playground. Hide and Seek was a favorite.

I can clearly recall thinking when hidden, that if I couldn't see Mary Hellen from my hiding place then she absolutely couldn't see me.

I can remember doubting this theory and checking it in the mirror. It tested out OK--I couldn't see myself unless I could see my eye. Thus Mary Hellen couldn't see me unless she could see my eye and if she could see my eye then I could see her.

Eventually I recall thinking how dumb this was. I realized that Mary could see my foot without seeing my head.

Now I know this "dumbness" was simply thinking logically but from an egocentric viewpoint.

* * * *

As I wrote last week, one of my math groups has been toying with some ideas in geometry. We've spent several days on the concept of infinity. I'm convinced that at most, perhaps 3 students truly understood.

On our third day of discussion the kids really caught me short. "Why does a line have to be infinite?" Kevin asked in a concerned voice. "Well . . .," I stuttered. I stalled for time. I then said, "How would you know if they were parallel?" "Well, says Mindy, "they could go just as long as you needed and then stop." I was stumped. I agreed to let them stop "when you were done with them."

Later on I began questioning myself. In high school geometry I had just accepted the idea of infinity. These kids had to "know" it completely. No loose ends. They had to make this concept more definite (more concrete) before they could accept and store it. They were satisfied with infinite that stopped "when you don't need it anymore."

My first reaction was--Man, was I ever comparatively dull, never questioning, just accepting--but not understanding.

My second reaction was--I personally didn't need to question in order to understand. On the other hand my 9 year olds had to bend the idea of infinite to make it fit with their present frameworks--this required questions--I'm very glad the kids could verbalize these doubts, felt free to express them, and could mold my "definition" to fit into their ideas of reality.

Cynthia Wiegand

Some Observations for Education by Thomas O'Brien

"There's one important balance to be kept between conserving old ideas (lest we fly to pieces) and creating new ones (lest we not fly at all). Right now the balance in education is way off center." I can live and teach with a statement of this type. I need the security of the old ideas, but I want to try new things. I will even agree with the idea that education is not in balance.

* * * *

Ryan: Because of Ginsburg's book, I spent time working and analyzing Ryan. He has been having some difficulties with his math facts.

Observation 1: He didn't use the pictures and rapidly wrote his answers which were done correctly. We stopped to look at the pictures, and he had difficulty relating the numbers in the fact to the pictures. I think he probably has his facts memorized, but does not have real understanding.

Observation 2: He has three methods for figuring out subtraction problems.

He seems to use the methods randomly without specific reasons. I noticed the first method when Ryan subtracted 3 from 10. He uses his fingers in the following way: He takes 3 from one hand and then adds 5 from the other hand to the remaining 2 to get to 7. I think this is pretty complicated, but he does quite well with it. On a recent paper, all of his mistakes resulted from failing to add the 5 in. Another method Ryan uses is counting backwards and using his fingers as record keeping. For the problem 6-2, Ryan will put down a finger saying 5 and then put down another finger saying 4. This way he sees two fingers pressed down, and he has said the answer 4. His third method is just to hold up the fingers and take away the required amount.

* * * *

Some personal, private, parting thoughts not at all related to each other:

Even though I am not completely in agreement with you as to how and what we should teach children, I do appreciate your obvious love and concern for children and American education. You seem to be an observant, caring, thoughtful person.

Somehow I have learned in a new way from this class that each human being has unique qualities. Each of us assimilates in our own individual ways. (Whispers from Piaget maybe) When we perceive and act upon our perceptions this becomes truth for us regardless of what the source of information intended us to believe. This then means, that as communicators in the classroom as well as in personal relationships, we must be diligent listeners. We must listen carefully to responses, so we can determine whether or not we have communicated what we intended.

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More of my thoughts on listening:

On Listening

You popped into my classroom this morning bright, eager, anxious to share. You ran up to my crowded desk brimming with your special news. I was collecting lunch money--milk money--book order money--I said, "I'll listen to you later."

You raised your hand excitedly to speak as we started phonics class (pages 10 and 11 in my big red plan book for the school board). I said, "Hands down. We want to learn our vowel sounds so we can be good readers."

You skipped in after lunch still anxious to talk to me, still wanting to share. I was snatching a few moments to complete the vertical curriculum report and John's transfer papers due in the office at 3 P.M. I said, "Recess time. Run outside and play."

You slowly approached my desk after recess as I was grading math papers. You stood there quietly. I said, "I'll listen in just a second. I want to finish these papers."

You tried to share your news once more as you walked past me on your way to the bus. I said, "Hurry, you'll miss your bus."

You peered at me out the window of the big yellow school bus as it lumbered down the road. I realized I had been too busy today, too busy to listen. I promise, I promise, I'll listen tomorrow. I wonder . . . will you have any special news to share with me then?

Barb Emling

The big discovery of the week was that the bead strings were not just an addition tool. We began the chapter on subtraction past ten. I asked them to tear out their page and begin to do the problems. These were warm-ups and were facts below ten but still very few pulled out their beads. It dawned on me that of course some of the children didn't realize the reversible nature of their problems even though we had discussed it often. It took very little explanation for them to begin working away on their beads at their subtraction work. The subtraction to this point, however, is not as successful on the beads as was the addition. I think I can attribute some of this problem to the same problem I'm experiencing in other areas of the curriculum . . . pre-holiday-itis.

Charlene Modla

Tryouts of Activities--I took a small desk and put a partition in the middle. I put a chair on each side of the partition. I then had a child sit in each chair. I gave each child a set of counting blocks of various colors. Each child had the same amount and same colors. Then one child would build something with the blocks and describe what they were doing to the other child, who had to try to build the same thing. Then we would switch and the other child would do the building and explaining.

Observations of Children's Thinking--I definitely learned more in this activity than the children. I learned so much more about my students than I knew before. It was so interesting to see all the different levels of thinking and language and capability of communication in one class.

The children's egocentrism was also very easy to see. Many of them felt the other person should just "know" what they were doing or thinking. Also many of them, when they were receiving the instructions, just went ahead and built what they wanted. I also had a few who just really could not communicate to the other child what they were doing. It was really frustrating to them. I also found that many of them could not use the terms "on top of," "under," "beside," etc. I can easily see how this can be a great diagnostic tool, far better than some of the ridiculous standardized tests that we use.

Gail Ahrens

Another interesting part of the interview with Hassler Whitney was the discussion of "taboos" in the classroom and their result in children. I thought the discussion of "Do not count on your fingers," "Don't get materials until you are told to," "Don't play around," and "Don't guess" are very significant since they go along with what we have discussed in class, which is letting children think and discover on their own. A very important quote from this section about taboos in the classroom follows: "All these things are things that if you were allowed to do--play around with things, try them out, see what happens--then you would start understanding what's going on, understanding how numbers are working together and, hence, getting a grasp of what mathematics is all about and how it applies to each problem in turn." I believe Professor Whitney's answer to the title question (Can children remain themselves in the classroom?) is only if the teacher will allow the students to discover, explore, and experiment on their own.

Anne Betscher

This morning's math period was interesting: I was working with about 12 nine-year-old students. We were discussing the idea that 3 points define a triangle. We then went on to discuss (although not resolve) the idea of infinity of length. Out of the blue, Roger says, "I can have three points and not have a triangle!" "How's that?" I asked. "If the three points were all in a line you wouldn't have a real triangle--it would be flat!"

How rich! (to borrow some TCO'B jargon). My x-response would have been: "Yes, that's true"--and then on my merry way. Now I can begin to realize Roger's capabilities.

Before I would have defined infinity and trudged on. Now I realize that some may not have the mental structures necessary to deal with this concept. Now I realize the richness of discussing infinity, imagining infinity, saying what is it not.

When Debbie says she understands infinity but cannot see that the points AB and BC identify the same line I know she may not know infinity.

When Amy says, "I know but no one can really '_know_' it," I can begin to understand what she is dealing with in her mind.

Cynthia Wiegand

The Witch's Captives

Players must name members of a category that the witch has not yet named in order to avoid becoming her captive.

Players: 10 or more

Materials: None

Game procedure

1. Players sit in a circle.
2. One child is chosen as "witch" and stands outside the circle.
3. The witch chooses a category of things for all of the players to belong to, such as all animals or all clothing. The players and the witch

maintain the same category throughout the game.

4. The witch names as many members of the category as she can, for example, "Are there any cats here? Are there any horses here? Are there any dogs here?" and so on.
5. Players do not answer the witch, but each must try to think of a member of the category that the witch has not mentioned.
6. When the witch cannot think of anything else, she gives up.
7. Once the witch has given up, each player takes a turn telling the witch what he or she is.
8. Each player must be a different member of the witch's category.
9. The witch may take any player who (1) cannot think of anything, (2) names something the witch named, (3) names something already named by another player, or (4) names something that does not belong to the witch's category.
10. Captives must leave the circle and go to another part of the room.
11. A new witch is chosen from the players who have not been captured.

We played the game as described, but we limited the witch to naming only 4 items in the category. At first the witch needed help thinking of a category; but after we played several games, the children were able to come up with many ideas. This is an excellent game of classifying as well as developing listening and attending skills.

Sentence Tic-Tac-Toe

Two players try to win a row of squares on a matrix by making sentences from pairs of words.

Players: 2

Materials: Paper and pencil for each player.

Game procedure

1. Each player secretly prints four words.
2. A player draws a simple matrix of four spaces across and down.
3. One player prints his words above the four spaces across the top.
4. The other player prints his words by the four spaces down the side.
5. Each player chooses X or 0 as his mark. Players take turns trying to win squares on the board. To win a square, a player must be able to use the words above and beside that square in one complete sentence.
6. The first player to complete a row, column, or a diagonal wins the game.

We did this game as a group and used team captains. We also did it with Thanksgiving words which the children really enjoyed. I think it is an excellent game. It would make a super seatwork activity with modifications. It was good for strategy as well as verbal organization.

Observations of Children's Thinking

Brian: I was helping Brian with a page of math facts that he had done incorrectly. To get the answer to 3 + 4 he used the following procedure: He found 3 fingers on one hand; then he found 4 fingers on the other hand; his final step was to count the two sets and join them by tapping his chin with each finger.

More on Brian: Brian's mother is a first grade teacher in my unit. Evidently she has encouraged Brian to learn the math facts "in his head." She is very concerned over the fact that Brian is not learning these facts and is even having trouble getting the answers correct on pages where there are pictures to count.

Ginsburg says children have a method to their mistakes and their errors can be analyzed. So I watched Brian as he did his math assignment. He was able to do plus or minus 1, 2, or 0 with any number under 10. When he did the problem, 10-2 he wrote the 8 immediately. When I asked him how he got that answer so fast, he said, "I took 10 and 9 away." At one point he wrote down several wrong answers. There were no pictures to refer to, so I asked him how he got those answers. He said, "I knew them in my head." I told him his answers were wrong and asked him how he could find the correct answer. He put his fingers up right away. (Probably his mother doesn't want him using his fingers.) Another time he wrote an incorrect answer without even looking at a picture next to the problem. When I told him to look at the picture, he did not count correctly.

Brian needs more counting experiences and he needs more concrete objects when doing math facts. He also needs to distinguish between the answers that really are "in his head" and the ones that are not there yet.

I made happy face buttons for the 110 kids in our primary instructional center. I asked several children to count out 25, and then I said, "I meant to tell you to count 23." This is what happened.

Philip: second grader--counted 25--when asked for 23 instead, he said out loud "take away 2" and then he did it.

Sharon: second grader--counted 25--immediately took 2 away without saying anything.

Michelle: first grader--counted out 25--needed help to name 11--looked at me in a funny way when I said I needed 23--then she said, "Wait, I want to count all over."

Brian: first grader--same Brian I have been working with--When counting to 25 spread the buttons all over--(the other kids piled them up as they counted). When asked for 23, he recounted all the buttons leaving them spread out--this method of counting was not as organized as the other children's because he could not keep track of those he had touched.

Margaret Read

We had an interesting experience in subtracting from 11. We had spent a couple of days working with sticks, counters, beads, etc., finding combinations which made 11. We did addition problems with no difficulty. Some of the children counted things, others counted fingers beginning with one number and counting the other because they do not have 11 fingers, one child counted ten fingers and her nose and counted out each number. Others remembered which combinations had been 11 and did not count at all. Then, we moved on to subtraction, beginning with eleven objects and taking some away and getting the results. Several children realized that we'd had the same combinations when adding. The first page we did from the math book was a surprise. Six of the 15 children present that day did 11 - 3 = 13, and similar things. I could see immediately what had happened. When I asked, "Tell me how you know that," none of them could tell me. One little boy did say, "I don't think that's right. Thirteen is more than 11 and you can't do that." We went back to sticks and worked them out, but the source of the confusions eluded me for a while. Then I realized. We had done two place subtraction without re-grouping. They were trying to subtract ones and then tens because we had done it there. Neither process has real meaning for these six.

Brad Huber

I wanted to design an activity that was flexible enough to allow for the differences in stages of growth, that provided some realism, that would lack all but the most necessary of rules, and that might allow for some lateral growth, that is children learning or looking for things other than those I purposely wanted them to see. I decided on map study.

I decided to allow more time than the usual confining "block periods" hoping to avoid the constraints of losing valuable learning. We expanded our period from 45 minutes to 75 minutes. The children were asked to bring maps from home that their parents didn't want. By the time we were ready to begin we had a box full of maps.

To make the first session less confusing, we used only the maps of the 50 states. The children were asked to select ten states and to find various "umbrellas" for their states. They worked in groups of five. My only requirement was that someone in each group keep track of the "umbrellas" used.

In every group the ideas generally moved from less complex to more complex as ideas were exhausted. For example, the children generally began by comparing size, i.e., these states are small and these are large. However, by the time the less complex umbrellas were used, the children began searching for things like altitude, land boundaries, water boundaries, or population. Lateral growth was taking place as children began using language to describe something they knew rather than using words to describe something they didn't.

On the second day the children ordered their set of states from smallest to largest. They were encouraged to use anything they wanted to, including graph paper to help. This day was by far the most difficult for them as time after time the groups asked for help. The students quickly recognized that states like Colorado and Wyoming were easy to order while Florida, Maryland and Michigan were not. Most of the groups got around to tracing the states on graph paper and counting the squares and the children were in most part agreeable on how to count the partial squares.

On the third day each child ordered his own set of states. This time, however, the states were provided and each set included five states of different scale. Most of the children did not recognize that scale was of importance unless New Jersey and Texas were ordered incorrectly and the child knew that Texas was supposed to be bigger. In other words, ignoring the scale of size the children could order the states. Most could not, however, determine how to order them because the idea of scale is still too abstract.

The session was an unqualified success because I really think we did more work in measuring, comparing, ordering, and language experience skills in three sessions than we normally do in a much longer time and each child was actively involved for extended periods of time. Each child learned what he was equipped and ready to learn and the session was broad enough to allow for a wide range of experiences rather than a singular objective.

Charlene Modla

I gave each group of children in my Kindergarten a piece of yarn and asked them to find the middle.

Naturally each group went about doing this in a different way. One group decided to fold the yarn, make the two ends meet and the place where the yarn folded was the middle. One group laid their yarn out on their table, looked it over, chose a spot that they felt was the middle, and then put a pencil on that spot to mark the middle. One group decided to tie each other up in the yarn and play horse by putting the yarn around one person (the horse) and another person hold the two ends and guide the horse. They found lots of creative ways to use the yarn, but they weren't too interested in finding the middle. Another group put their yarn down on the floor and each one chose the spot they thought was the middle.

Observations of Children's Thinking:

First I ask the group that had folded the yarn if they were sure the point they had found was the middle. "Yes," they were sure it was. When I asked them how they decided to fold it or how they knew they could get the middle by folding it, they could not tell me. They said they just knew when you folded something you could find the middle. I asked them if both sides of the yarn, from the middle to the end, were the same length. They had to think about it, but then decided they were the same. Then I asked if the ends of the yarn did not meet, or were not the same, when you folded the yarn, and showed them by folding the yarn so that the ends did not meet. Did we still have the middle? "No," they said that was not the middle, the two ends had to meet to have the middle. Then I asked if any time we find the middle of something are the two parts on each side of the middle always the same? They weren't sure of anything else, they knew it was true for the yarn, but they weren't sure of anything else.

I then asked the group that had placed their yarn on the table to find the middle, how they found the middle. They told me they didn't know how they found it, they just knew that was the middle because they could tell by looking at it.

I then went to the group that had placed their yarn on the floor. They had each found a point that they thought was the middle, each one was different and each one knew that the point they chose was the middle, just because they knew it was.

When I went to the group who had used the yarn to tie each other up and play horse, I asked them if they had found the middle of the yarn. They wanted to know why I needed the middle and what was I going to do with the middle!!

Sally Sidwell

In my activities this week I worked with five, six, seven, and eight year olds mostly. When I asked them to add two sets (used Teddy Bear counters) the five and six year olds moved the two sets together physically and then counted all the objects in the new set. My seven year old did not have to physically move the sets together but was still not to the stage where he could say that one set had 6 bears, for example, and the other set had 3 so 6, 7, 8, 9--9 objects altogether. He had to say 6 + 3 but then had to go back and count them all over from the beginning. The eight year old students were able to quickly look at the two sets and give me an answer.

* * * *

The articles I read this week stressed having the students learn by building on concepts and being able to apply these concepts to various situations rather than learning by "rote." This idea really hit home to me this week during a Social Studies class. I had fifth grade boys studying for a chapter test. Their teacher had told them the various items to be covered on the test. In our studying I asked what "parliament" was. One boy piped up and said that wasn't going to be on their test so they didn't have to know that. Here these boys were studying the Stamp Act, Trade Laws, etc., and did not know that Parliament made these laws or even that it was a group of men.

This incident made me stop and think about all the times I have drilled my upper grade students for Social Studies or Science tests when they may not have really been able to relate some of the concepts with their experiences and so may have "memorized" them for the test but promptly forgot them afterwards.

I am putting forth a conscious effort from here on to not take it for granted that my students "know" certain things just because they have been exposed to them in previous years.

Linda Van Valin

The children in my Kindergarten class cut out 4 in. circles. Each child taped his circle on a circle item in the room. Each described, in sentences, where his circle was--without showing the class. This was a good language activity, too. We tried the same activity with squares and triangles. Later we can try other shapes.

Cynthia Wiegand

Friday was a rainy day, so I had the children make an umbrella on paper. I showed them a real umbrella of my own which was plain navy blue. I told them to make their umbrellas special and different and not to look at their neighbor's efforts. After the umbrellas were complete, I called about 10 children up to the front of the room with their umbrellas. I separated the umbrellas into two groups and the class tried to figure out the rule for the division. One time I put all the straight handled umbrellas in one group. Another time it was all the plain colors. I did this until every child's umbrella had been used and the children understood how to play the game. Next we divided into groups of five children each and told them to play the game in their groups. I gave no instruction as how the groups should operate. Every child was able to find characteristics and gave ideas. In most of the groups each member gave an idea which was tried by the group. One group had a strong leader and he generated the ideas until I told them to take turns.

One group got into a disagreement because one person wanted to make a pile of umbrellas with green and another pile without green. They didn't have any umbrellas without green, so one girl was going to put her umbrella down in the non-green pile (even though it had green) just to make her categories work out.

I was pleased with the children's thinking and enthusiasm. They came up with numerous categories: curved handles, straight handles, stripes, plain, things attached, no attachments, balls on the edge, plain edges, ribs showing, ribs not showing, and many others.

Norma Whited

Bruner in "The Perfectibility of Intellect" (in The Relevance of Education) makes comparison between the Kung Bushmen and instruction as we know it. Among the Bushmen there is constant interaction between adult and child--they play, dance, sit, hunt, sing and story tell together. One never sees an instance of "teaching" taking place outside the situation where the behavior to be learned is relevant. Bruner believes we have developed a technique of instructing our children based heavily on telling out of context rather than showing in context.

Margaret Read

Asked to explain why 7 and 8 are 15, several of my children told me, "it just is." A couple told me that "If you make 7 circles and then make 8 more and count them all there will be 15." One told me that "If you start to count with 7 and count 8 fingers you get to 15." Although they did not actually use circles or fingers to get an answer, these children seemed to have a mental image of what the answer was. One boy had to count from 1 to 7 before beginning to count his eight fingers.

Ginsberg suggested that children with a good grasp of numbers add tens first when adding in their heads. I asked the little boy who had started counting with one to add 21 and 32. He counted from 1 to 21 and then started counting fingers. He was trying to keep track of how many fingers he had counted while counting and unconsciously shifted in his counting so that he ended up by saying 32. When I showed him the problem written down he told me it was 53. Asked if that was what he had gotten while adding in his head, he said, "No, but it doesn't matter. It's 32 if you do it in your head and 53 if you write it down." Another boy added 24 and 31 and got 28 because "24 plus 3 is 27 and 1 more makes it 28." Another boy added 23 and 22 in his head and got 25 because "three plus two is five." On seeing the problem written down (he had suggested that it would be easier if he had paper) he told me immediately that it was 45. Still another added in his head and got 57 because "3 plus 2 is 5 and 2 more is seven," and on seeing the problem, he added horizontally instead of vertically and got 54.

General Observations, Comments

Children seem not to be terribly disturbed by getting two different answers for the same problem. None of the children who got two answers, asked which was right. They all seemed to feel, as the first boy did, that it's one thing if you do it in your head and another on paper. Unlike computing smaller numbers, they have no clear "picture" of 22, 32, 54, etc.

Romona Ray

Observations of Children's Thinking:

I used counters with my second grade remedial math student (Brian) who always counts on the clock or alphabet line (his regular teacher has him use # lines). When he did this problem (6 + 5) at first, he took 6 red counters + 5 white counters. (The other student, Allen, who comes when he does was having difficulty with counters because he didn't color coordinate.) I asked Brian why he selected color coding. He said, "It's easier to tell that I have enough." I believe that is good organization.

Barbara Grigg

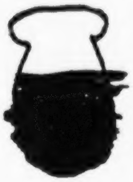
I think we teachers box ourselves in too often by only asking questions with one right answer. This past week I've tried to broaden my horizons and have noticed my students are responding enthusiastically. When we first started these types of activities one boy stated, "I hate to think—it makes my head hurt." After we had done several of these activities and he was very much interested and involved, I teasingly asked him, "James, had any headaches lately?" He laughed and told me, "Well, this ain't so bad. I kind of like it."

I think most of the kids would agree with James and say--"Well, this ain't so bad. I kind of like it."

Charlene Modla

I had a paper that had 5 monkeys on it. I asked Betty to count the monkeys. She counted 1-2-3-4-5. I then asked her how many monkeys were on the page. She had no idea. She could count them, that is, she could say the number names, but she had no idea how many there were.

1.



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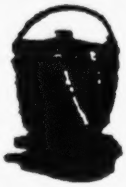

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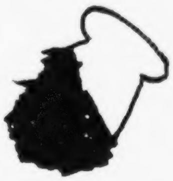

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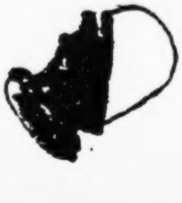

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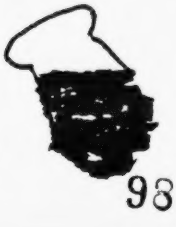
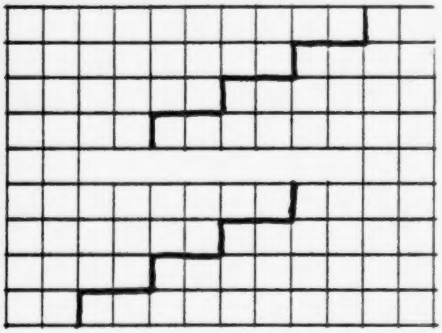
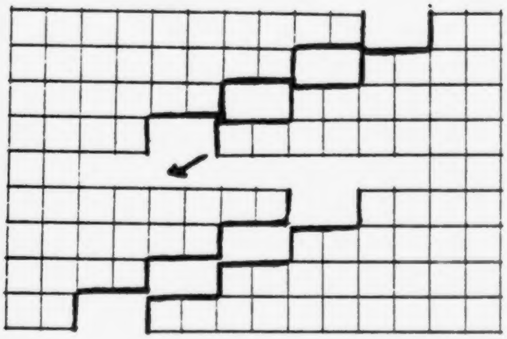


6.

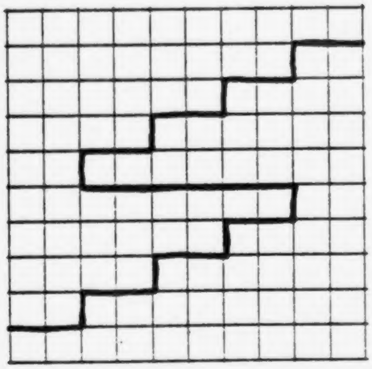
This is the answer to Jim Beattie's "Make a Square" from page 6.



Make cuts along heavy black line.



Move as indicated.



10x10 showing where cuts fit together.

Scatterers

Gail Ahrens
Maryville West School
Maryville, Illinois

Jim Beattie
Madison Middle School
Madison, Illinois

Anne Betscher
Mulberry Grove Elementary School
Mulberry Grove, Illinois

Cindy Blumberg
Belle Valley North School
Belleville, Illinois

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Karen Botterbush
Southern Illinois University
Edwardsville, Illinois

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Mulberry Grove Elementary School
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Highland, Illinois

Julia Hodges
Beckemeyer School
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Kathy Holzhauer
Highland Community School
Highland, Illinois

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Carlyle Grade School
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Helen L. Miller
Logan School
Granite City, Illinois

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:SIGH:
Tom Fletcher

SEEDBED

SEEDBED

SEEDBED

Number 12

August, 1982

Teachers' Center Project

SIUE

Southern Illinois University
at Edwardsville

INTRODUCTION

It's a pleasure to introduce SEEDBED 12. It represents the work of teachers from twelve school districts as well as two other groups of SIUE students - undergrads who are doing their Field I experience (first exposure to working with students on a day to day basis) and returning mature students who have raised their families and are back for more education. These people have met at the three Teachers' Centers (Belleville, Edwardsville, and Greenville) during the last two quarters.

We believe that the quality work these teachers produce is evidence that the media stories about uncaring, ineffective, and poorly prepared teachers have been overstated. Poor teachers no doubt exist, but those we meet with are super - they're vitally concerned about the total well-being of their students. They are "hungry" for help in learning more about children and intellectual development in order to do an always better job of providing opportunities for their students to learn - not just facts and rules but many kinds of thinking, reasoning and problem solving skills.

These teachers aren't rank newcomers -- some of them have been involved in Teachers' Center activities in the past; some of them heard of our work from other teachers who have been involved. They've formed a sort of loose-knit network among themselves and other teachers we've never met. They spark and challenge one another's thinking, they support one another's growth, and guide one another's reading.

We invite you to become part of this network. You do that by reading and trying out ideas and by following Tom O'Brien's #1 rule: "If you run across something good, you may not, under any circumstances, keep it to yourself." Share with your colleagues and share with others along our network by *contributing an article to SEEDBED 13.*

Join us in the view that knowledge is not a spectator sport.

Shirley A. Casey

Shirley A. Casey

Edwardsville, Illinois
July 28, 1982

ABOUT THE COVER

The drawing on the cover is just one of many that were part of a thoroughly enjoyable journal kept by Tom Fletcher, who has just completed sixth grade at Walnut Grove School in Florissant, Missouri. Tom started the journal at the suggestion of Mary Steffen, his teacher.

ABOUT THE POEMS

The poems that appear throughout this issue were written and illustrated by students at Carlyle Junior High School. They took part in a Great Books Program for the gifted which was sponsored by Cheryl McAllister, Cynthia O'Neill and Cheri Davis.

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SEEDBED SPECIAL ISSUE

We are pleased to announce a special issue of SEEDBED entitled "Away From Basal Texts". Tom O'Brien recently saw the texts that are available and found them appallingly bad. "Away From Basal Texts" is a collection of quality print materials for children from offbeat publishers that we think will be of great interest to teachers. Samples from some 16 publishers along with publishers information are given. Copies are available for $2.50. An order blank is provided for you convenience.

- -

Please send me the special issue of SEEDBED, "Away From Basal Texts". I enclose $2.50

Please send me the next issue of SEEDBED as it becomes available. I enclose $2.50

Please send me the next 4 issues of SEEDBED as they become available. I enclose $10.00

NAME ____

ADDRESS ____

CITY ______________________ STATE __________ ZIP __________

DATE ______________________

Mail to:

Teachers' Center Project
Box 122
Southern Illinois University
Edwardsville, IL 62026

Area

Anne Betscher

The following sequence of ideas helped me this year in helping my fourth graders grasp the idea of measuring area. Perhaps some of them can be bent to help you in your classroom. They were formulated and borrowed after our Greenville Teachers' Center discussion on area.

1. On an overhead projector I established the conservation of area. (I guestimated that the group would be able to establish this concept without physical manipulatives.) I outlined five graph-paper squares and asked "How much" was inside the line. I outlined five squares in a very different shape and repeated my question. I did this several times and then repeated the exercise with an area of eight.

I then handed out graph paper and asked how many ways 7 could be outlined. They guessed and then tried. In trying some initiated the use of two half squares to make one whole.

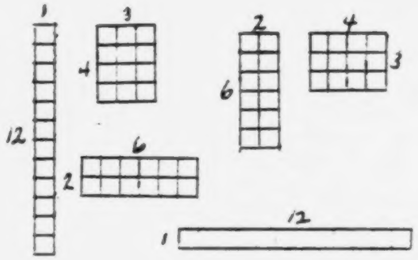
2. The following day these students explained their "halves" to the other students - convincing them that half and half make a whole. I allowed another day on the area = 7 assignment. Later I found that only one student had misunderstood the idea that two halves equals one whole. She assumed that any partial squares counted the same as a whole square.

3. I outlined more complicated shapes on the overhead and asked their areas. Class members explained their personal "systems" for counting. Many counted whole units, paired halves, and then added the subtotals. After practicing as a group each student outlined several larger shapes on graph paper. All included half squares. They then traded papers and calculated

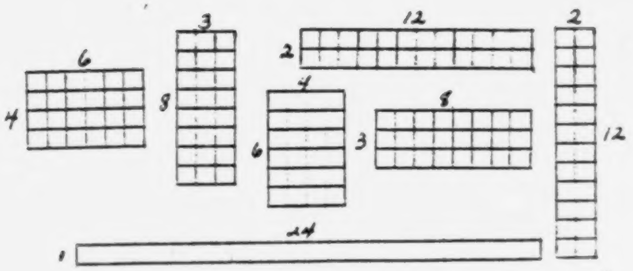
each other's areas. (The results made an impressive bulletin board display.)

The large shapes outlined prompted the development of several strategies. Many students divided the larger shapes into smaller, more manageable pieces. Two even developed the l x w = a formula for the "regular" parts of their shapes. Some painstakingly counted each unit.

4. The next day I outlined a = 12 in the following ways:



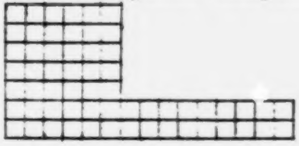
I then outlined a = 24 in these ways and asked the area of each.



Is there a trick we can use so we don't always have to count? Most immediately saw the factors in the dimensions and thus the "trick" for figuring the area. Those who did not "see" on their own seemed to recognize the relationship after others had pointed it out. I showed them the symbolism to describe this trick and introduced the term perimeter and clarified the definitions of length and width. We also discussed the purpose of figuring areas. (We later discussed the sense of estimating areas.) One student commented that most shapes weren't "perfect". We got off on another issue and I reintroduced this idea the next day.

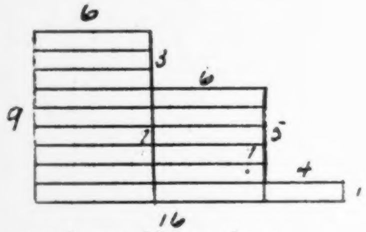
Because I feel that the kids need to know how to survive textbook work, I assigned 3 pages where l and w were given in various units and a = ___?___ was asked for. We had recently taken our achievement tests and I explained that they needed to know the book way to do well on such tests.

5. The next day we tackled irregular shapes. On the overhead I drew a shape like the following.



How can we use our trick to help find the area of this shape quickly? Without further hints they suggested making two rectangles. They argued over which way to divide it and some were surprised to find that the total areas were equal.

I then drew a similar shape on ungraphed film and provided the dimensions in numerals only. Several different answers were given, all with confidence. A student suggested drawing in the squares to prove who was correct. After discussing both successful and unsuccessful means most found their errors in calculating ungiven dimensions. (see following example.)

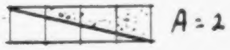


Many were surprisingly very sophisticated at finding ungiven dimensions. Others relied simply on visual estimation. Because most of the figures could be reasonably divided in several different ways, the more advanced students sought the most efficient means of division while others were satisfied using the first alternative that came to mind.

6. Several students wanted to know the trick for finding the area of a triangle. We looked at several isosceles triangles with 90° top angles. The area of these triangles could be counted with tools available to the whole class. They discovered that to find the area of these special triangles "...you take the bottom number, take half of it, and times it together. That

is, $a = (\frac{1}{2}b)^2$."

We had a great argument over whether the diagonal distance of a unit was equal to the length of one side. Many were certain that they were the same length. Their logic was interesting. Some suggested that the lengths must be the same because there was no way to tell how long the diagonal was if it was not the same. One boy suggested that the distances were the same in small squares but that the diagonal distance was longer in big squares like baseball diamonds. The dilemma was never completely resolved but it did give me a chance to tell them a bit about a man named Pythagoras.

Three students seemed to comprehend the following concept: 

These students might possibly have found "tricks" for other triangles but lacked the drive to do so. A geoboard might have helped others understand.

From this short unit my kids learned a good deal about measuring area. Their understandings of physical relationships grew. They were allowed to discover the magic of math. The whole topic "went somewhere". Not only will the kids better understand area, but the experiences also provided practice in "real" subtraction and addition and in numerical multiplication and addition. It introduced mathematical symbolism and terms such as perimeter, length, width, base, formula, hypothesis and theory. It reviewed right, obtuse, and acute angles, diagonals, symmetry, rectangles, squares, triangles, linear units of measurement (English and metric) and the need for standardization.

Besides all this, it taught me a great deal about the logic and mental levels of my students. It taught me about kids' minds while teaching kids' minds about their world.

It could never work the same way twice. But I feel the ideas borrowed from our Teachers' Center meetings were too valuable not to share. They can be bent to help kids at many levels learn about measuring area.

Applying Piaget's Theory to Third Grade Math

Norma Whited

My teaching this year has taken on a new dimension as I've been introduced to Piaget's theory of intellectual development. I have, for a long time, used some of his discovery techniques without ever having heard of Piaget.

Early in this school year I began using more and more of the Piaget oriented tasks with my math students. My math file has become full of such things as magic squares, finding shapes, making designs with graphs, following directions (isolating and controlling variables), breading codes, crypto, tangrams, etc. I have also used Piaget's conversation tasks on several of my children and have found that I have some preconservers, some are transitional and some have reached the conserver stage.

Colored one inch squares cut from construction paper have proved useful in helping my children construct relationships through their own experience with manipulation of these objects. Piaget says that number relationships are constructions of the mind that cannot be transmitted verbally - only by doing.

The second semester my third graders are introduced to multiplication. They hear about petals on flowers, ants on anthills, bugs on leaves and frogs on lilypads. They use the colored squares to make sets. We use records, singing the multiplication facts and some flash card activities.

Piaget probes beyond children's superficial rote memory methods to their understanding of number. His findings reveal logical ideas that are important in the child's understanding of number. Once the logical ideas have been developed, the child can deal with number operations as part of a system of related operations.

So....children can memorize facts without a firm understanding of the meaning of number. This superficial understanding of number has little or no connection with real word objects or situations. So often we focus on the end product rather than the thinking process that underlies it.

In thinking about this I ask my students to write a story that this equation would solve: 6 x 3 = 18.

Here are some of the results reproduced as nearly as possible.

Kim: I went to the store and there were three crayon boxes and in each crayon box there were six crayons. How many crayons were there? 6 x 3 = 18

Mike: Once I knew a person who could eat 6 eggs in one minute. One time he ate for 3 minutes. How many eggs did he eat? 6 x 3 = 18

Rodney: Once I say a kid who could lick 6 in one punch and I saw Pat could lick 3 kids in one punch. 3 x 6 = 18

Margo: Each girl took 3 baskets. 6 girls went on a picnic. How many baskets did they take? 6 x 3 = 18

Daryl: The bird had 6 eggs. Linda saw 3 eggs. How many did she see? 6 x 3 = 18

Patti: Mary had 6 doughnuts, Jon had 6 doughnuts, Lynn had 6 doughnuts so 3 children had 6 doughnuts. How many doughnuts do they have? 6 x 3 = 18

Rowdy: Pat had 6 coats. On each coat Pat had 3 buttons. How many buttons in all? 6 x 3 = 18

Tom: There are 6 boys and 3 girls. How many is this? 6 x 3 = 18

Shane: Mark saw 3 seashells. Pat saw 6 seashells. How many shells did they see? 6 x 3 = 18

Pat: 6 children were in each car. 3 cars went to the zoo. How many children went to the zoo? 6 x 3 = 18

Mike: Tommy has six popsicles Jenny has six popsicles Eric has six popsicles so three children had six popsicles. 6 x 3 = 18

Easy to detect, is the fact that some kids actually saw the reality of 6 x 3 = 18. Others who had memorized the fact and had possibly fooled the teacher had no understanding of the meaning of the operation.

Knowledge is construction. We teachers need to provide the environment and adapt our teaching to children's natural ways of learning.

* * * * * * * * * *

About Myself

Barbara Grigg

This is a great first day activity. Students are usually apprehensive about the first day of school and this activity allows students to express some of their inner feelings.

I feel nervous when ______________________________.

I wish people wouldn't ______________________________.

It makes me angry when ______________________________.

Better than anything, I like ______________________________.

I feel proud when ______________________________.

This year, I hope ______________________________.

One thing I'd like to know about the teacher is ______________________________

______________________________.

Something I want to happen this year at school is ______________________________

______________________________.

One thing I'd like the teacher to know about me is ______________________________

______________________________.

Unlocking Me

Barbara Grigg

1. What do you like to do when it's raining outside?

2. What's your middle name?
3. What do you like best about your teacher?

4. What do you do with most of the money you get?

5. Who is your best friend?
6. What is your favorite story?
7. What is your favorite number and why?
8. What do you daydream about?

9. If you were a flower, what would you be?
10. What do you like best about school?
11. What would you do with $100.00?
12. Tell about the best present you ever received.

13. What is the thing you like best about yourself?

14. Share something nice about your family.

15. What does your teacher like about you?

16. What makes you laugh?

If I . . .

Barbara Grigg

1. If I were invisible, I'd ____.

2. If I had to survive on three foods, they would be ________________________
____.

3. If I had to choose between being 2 inches tall or 20 feet tall, I'd choose
to be _______________ tall because _____________________________________
____.

4. If I could be a person from history, I'd be __________________________ because
____.

5. If I were shaped like a fruit or vegetable, I'd be a ______________________
because ____.

6. If I could change one thing about the way I look, I'd change ________________
____.

7. If I could choose another subject to take classes in at school, it would be
______________ because ____.

8. The most important things to have when you're grown up are __________________
____.

9. The most important job of a parent is ______________________________________
____.

10. The things I'll remember most about this year of my life are ________________
____.

Classify the Class

Evelyn Kay Krauss

STEP ONE: Children compile a list in which the class could be classified. Some examples are:

1. What is the color of your eyes?
2. How many states have you lived in?
3. How many schools have you attended?
4. How many brothers and sisters do you have?
5. What is your favorite book?
6. What is your favorite T.V. program?
7. Do you have a pet? If so, what kind?
8. Do you belong to an organization such as scouts or a ball league? If so, what is the name of it?
9. Does your mother work? Part time or full time?
10. What is your favorite subject in school?
11. What subject do you like the least?
12. How do you spend your free time?

STEP TWO: Allow students to work in pairs. They should select from the list one way that they would like to classify the class. They will have to approach each child for answer and record the answer.

STEP THREE: After all the data has been collected, the team decides how the information can categorized.

STEP FOUR: Students develop a graph illustrating how they categorized the students according to the information they obtained.

This would be a good fall activity in that new students would more quickly become acquainted with the other children. Students would learn more about each other. Also it would provide a class profile for the teacher.

Breaking the Ice

Judy Noeltner

During my substituting days I sometimes had trouble with names, so I used this learning device to learn children's names. The students enjoyed it a lot and they had to think extra hard about some of their responses. The first child would say "My name is Joan and I like jellybeans." The first letter in the name was the clue to their response; whatever the first letter of their name was their response has to start with the same letter. Some examples are as follows:

My name is Bud and I like bikes.
My name is Debbie and I like donuts.
My name is Sue and I like swimming.

In a regular classroom you can use this learning device first to break the ice to learn names at the beginning of the year and then as a fill-in activity when you have a few extra minutes during the day.

You can use classification by saying that your response still has to be the same letter as your first name but must be edible, or must be a city, or must be an adjective.

Older children can do this too. Expand the directions and say that whatever the child ahead of them said they have to repeat it plus give their own response. After you have gone through the class ask what did Joe like or Mary, etc.

This learning device rates right up there with "Around the World" and the students enjoy it. They enjoy it because they are able to give their own responses.

Using the Camera

Linda VanValin

A camera can be a fun and versatile visual aid for all grade levels. We have found it useful in kindergarten for many activities. These are some of our favorites:

SIZE: Take shots of the tallest, shortest, longest, smallest, etc.

SHAPE: Take shots of geometric shapes found in signs, buildings, vehicles, or anywhere.

SPEED & MOTION: Hold the camera still and photograph all kinds of motion - cars, people, bicycles, trains, flags and others. What happens? How are they similar? different?

SHADOWS: Take pictures of shadows of various things. Can others identify them? Take shots of the same shadow at different times of the day.

ABSTRACTS: Try to take pictures that show feelings such as love, joy, anger, frustration, boredom, fear.

IRONY: Take pictures of things that are funny or "out of place" -- a car in a "no parking zone", people walking when sign says "don't walk", signs on "post no bills", etc.

VOCABULARY: Take pictures of things in the inner city or country. Use these as new reading words. Make a book of the new vocabulary and pictures.

Interviewing Kids

Betty Bledsaw

It is important to be well planned for the interview. First of all, ask permission of the child's teacher. Let him know what you're doing. (She or he can be a useful ally.) Secondly, have in mind what questions you want answered or what things you want to watch. (Is the task a good one?) Finally, it should obvious, but have materials -- pencil, paper, tapes, tape recorder, etc. -- ready. Plan to have a fellow teacher handy for help in the interview. The last step in planning for the interview is to [illegible] a quiet place without distractions.

On with the interview. When the child arrives, set the mood. Be friendly. Be honest and be yourself. Introduce yourself if the child doesn't know you. Get down to the eye level or below with the child. Explain why you're doing this. (I take the pressure off by saying I won't use your name; we'll just talk.) Now you're ready for the interview. Have your fellow teacher watch the non-verbal clues and help take notes, or better still, take care of using the tape recorder. (Verbatim transcript of the child's interview provides an accurate record of what has been said. Teachers have a tendency to clean up the language. When they clean it up, they may miss phrasing, grammatical lapses, and vocabulary lags which have importance for cognitive assessment.)

Be patient. Learn to wait for an answer. Try to be matter-of-fact. (I guess the hardest one for me is not to coach.) Be flexible and be ready to pick up on what's being said. Use words from the child's vocabulary level.

After the interview, attend to additional notetaking or to the comments from your fellow teacher. What non-verbal clues did she/he pick up?--Was the child embarrassed, tense, shy, timid, all-knowing, alert, or chaotic? Whas there a lot of facial movement or movement of hands? What did the child do when he was thinking about the question or problem?

I also read that it takes lots and lots of practice to do a good interview. (Some authors say a year or more.) For myself, I think I need to check each time to see if: I did not make judgments, I was accurate, and that I tried to be honest about the child's and my own performance.

(Credit should be given to my fellow teachers and Tom O'Brien for hints and ideas for interviewing. Also, I used a part of a chapter of a book on child development. This book was written by David Elkind -- Child Development and Education.)

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The Shadow King

Deanna Aebel

Shadow Tag provides opportunities for exploring movement patterns. An "It" is chosen and attempts to tag another player by stepping on his or her shadow. Considerable skill can be developed by trying to manipulate the shadow so "It" cannot step on it. Bending, twisting, and stooping can cause the shadow to shift so touching it is difficult.

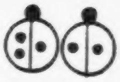
A player may also escape being tagged by running to the shade. (The Shadow Knows is from Scott, Foresman's You and Your Health, Book 2, Teacher's Edition.)

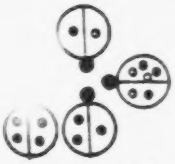
Note: If the children play shadow tag at different times of the day are different strategies needed?

Lady Bugs

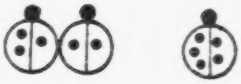
Carole Moeller

Use red construction paper to make lady bugs. Laminate. Children can group these as they do dominoes -- a simple process of adding and taking away (by matching dots). Heads always match.





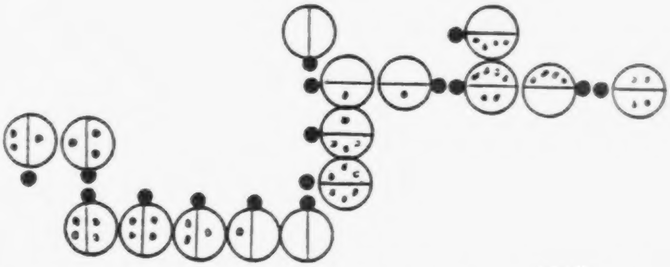
This game can be advanced by adding colored bugs. A pupil can put a yellow bug next to a red one, if dots match. Another child can add an orange bug (Red plus yellow = orange) or 3 dots + 2 dots gives 5 dots.



A child can add or subtract but must give a reason.

These can also be used for matching. For example, 2 bugs with 3 dots equals 1 bug with 6 dots or 2 bugs with 4 dots and 2 dots or 6 bugs with 1 dot each, etc. This game can be "reversed" - One player can match all the bugs but 4 or 5.

Example:



Each child who has a bug must take away 1 bug on the end if he can, bu must explain how or why he can. If he can't he misses his turn. Winners can be player with most "bugs", or player with most "dots."

Can Reading Be Fun?

Peggy Cook

In the Teachers' Center we discussed a subject that has long been a concern of mine -- teaching children to read.

In the book The Teaching of Young Children, edited by Molly Brearley, it is stated on page 61 that the child must see the purpose of reading... that what he reads must have a meaning to him: the mere reading of 'words' lacks any purpose.... Why then do we first introduce the written word to children by teaching them the frequency words - to, it, in, the, etc.? According to Bruno Bettelheim in his article "Johnny Wants to Read," children come to school with a well-developed vocabulary of, on the average, 4,000 words.... In order to excite children to read it is necessary to associate their already sophisticated oral vocabulary to the symbols of the written word.

In a lecture given by E. A. Orsborn to the Teachers' Center, he indicated that we should use children's own words for their own reading. This has been done through Breakthrough to Literacy. Under this program the child makes his own reading book that is personal to him and in his own language.

In a modified version of this program, a child can make his own set of "frequency" words that are exciting and important to him. Ask the parents to write a note or fill out a questionnaire that tells about their child's particular interest. For example, brothers, sisters, parent's occupation, favorite toys, pets, etc. Most important, include the child in gathering of this information. Then have the child draw a picture of these important items and print the name as well as any other descriptive words the child may wish to include under the picture. Now he has made his own personal book that he will read because it is important and exciting to him. As he learns to read his own book, he can share it with other members of his class.

In my home I have been doing some labeling for my 5-year old. This can be done in the classroom as well. On 3x5 colored cards print the names of different items in the room. Tape these cards on the particular item it names so the child can associate the written word to the item it represents.

Reading is fun and it is exciting but putting myself in the shoes of a young child being introduced to reading with such "exciting" words like to, it, in, the, makes me think of one word = boooooorrrring!

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Find Your Way To 100

Barbara Grigg

This game was invented by one of my students, James Hopkins, and his grandmother. When they constructed this game they thought there was only one possible route to get to 100. While working this game in class, we found many possible ways to get to 100.

Starting at 1 add all the numbers which will make a path (no skipping) to 100 so that the total of all the numbers will be 100.

1	6	11	4	6	4	100
18	16	7	12	4	7	1
2	20	8	9	10	20	9
8	15	5	2	8	25	6
17	10	8	8	30	13	11
3	10	3	19	5	4	10
1	5	20	9	19	17	18

How Much Is Enough???????

Helen Miller

Each day the children brought to school clorox bottles which were to be made into Easter baskets. Each day they were more and more concerned about the total number of bottles which were taking up more and more space.

Jennifer: Teacher, do we have enough bottles now?

Teacher: How many bottles do we need?

Jane: Enough, that's how many?

Teacher: What number will tell us what enough is?

Jane: (Quizzically) So everyone will have one.

Teacher: How can we find out?

Jennifer: Count them.

Teacher: Jennifer, what should we count?

Jennifer: Count the bottles.

Jane: Count the children.

Teacher: Will counting the bottles tell us if we have enough?

Jennifer: Well, let's do it.

(Jennifer and several other curious children go off to do the counting. It is a matter of moving them into a systematic order of four vertically and five horizontally. There are several that do not fit the pattern.)

Jennifer: There are thirty-three bottles.

Joe: Count the children.

Amy: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16. There are 16 I think. They won't stand still.

April: Teacher, teacher, teacher, I know, I know. Mary and I figured it out. Just count the lids.

(Several other children rush over to the bottles and begin removing the lids.)

Andy: (Very unobtrusively) That won't work. My mother gave me a bottle to bring, but she lost the lid.

Pete: Teacher, do I have to bring another bottle? Mine didn't have a lid, either.

Teacher: No, Pete, the bottle you brought will be fine.

(The looks on the faces of a few children indicated that the issue was definitely not resolved. Much speculating and alternative seeking seemed to be transpiring as the children clustered together in small groups around the room.)

Jennifer: I know. Give each child a bottle and see if there is one for everyone.

Teacher: We will have to have one for each of us in this class and one for each of the children in the afternoon class. There are 16 of us here and Lori is absent. Joe, will you get the peg boards and use one to show us 16 and one more for Lori?

(Joe proceeds to the peg board shelf and gets three boards and the container of pegs. He puts in 16 pegs and one for Lori.)

Teacher: How many pegs do you have on the board?

(Joe begins his count at one once more. Jamie is insistently saying 16 and 1 more make 17. Joe unheedingly continues the process of counting each peg until he reaches the final peg.)

Joe: 17 pegs.

Teacher: Fine, Joe. Thank you.

(The teacher pursues the questioning and the use of the peg board which the children have used many times to solve problems.)

Teacher: Jamie, will you put nineteen pegs on another board to show us how many are in the afternoon class?

(Jamie takes another board and quickly inserts the required number of pegs.)

Teacher: Kathy, can you show us, using the peg board, how many bottles we have?

Kathy: I don't remember.

Teacher: Jennifer, since you did the counting, will you work with Kathy?

Jennifer: I don't remember, either.

Teacher: How can you find......

Mary: I know, I know; it was thirty-three.

(The girls find a third board and complete the task. The two boards illustrating the number of children in both classes who will need a bottle for an Easter basket are shown to the others. The third board is held juxtaposition to the first two. The reaction of the children is quiet acquiescence to whatever authority requires. The problem from the children's point of view was still unresolved.)

Teacher: How could we see if there are enough bottles for everyone in our class?

Mike: Everyone stand in a line and everybody get a bottle.

(The children line themselves up across the width of the room.)

Jane: Don't forget Lori. She's not here today.

(Another of the participants gets an empty chair and places Lori's bottle on the chair.)

(After all the children present have received a bottle, they see a large quantity of bottles remaining. It is visually perceived by all that there are definitely enough bottles for each child present and one for Lori. There are still many bottles left. The teacher realizes that, in order to quantify the remaining bottles and, in order to reach closure on the issue for the developmentally advanced children, the number of children must be perceptually defined.)

(As the children are standing in a line with their bottles, the teacher reminds the children of the number of children in the afternoon class. She then moves the chairs into a line opposite the children standing.)

Teacher: How many chairs will we need for the afternoon class?

Jack: I remember. Nineteen.

Teacher: Tell me when I have the right number of chairs in the row.

(The row of chairs opposite the standing children encompasses the same distance as the row of standing children.)

Teacher: Is that the right amount now?

(Many of the children begin counting from one to determine the totality of the chair arrangement.)

Mike: You need three more.

Teacher: I wonder if there are enough chairs in the room?

Jane: Here's one.

Joe: Here are two more.

Teacher: Is that the right amount now to show how many children are in the afternoon class?

(Once again two or three children begin the count from one to determine the totality of the chairs.)

Mike: That's right. (rather impatiently)

(Teacher places one bottle on each chair. All the bottles have a place.)

Teacher: Do we have enough bottles for all the children in both kindergarten classes?

Some: YES.

Amy: (with a look of consternation) No.

Teacher: Amy, why did you say no?

Amy: There are three chairs that don't have a bottle.

Teacher: How many bottles will we need?

Amy: We're goin'na need three bottles, but my Mom doesn't have any.

Teacher: Maybe some of the children in the afternoon class will bring some.

A preoperational child learns best when the necessity for a solution is of personal significance. He is a visually learning and he learns by interacting with his environment. He attends to a task until it is resolved if he can understand what is happening and if he is a part of the process.

This activity was approximately forty-five minutes in length. It involved language, reasoning, one-to-one relationships, comparison, addition, subtraction, trial and error, and problem-solving.

One of the advanced children, developmentally, had taken a fourth peg board and arranged the thirty-three pegs in an order that was distinctly different from the original thirty-three peg situation. When questioned about the number being the same when the appearance was so obviously different, she seemed to question the intelligence of the teacher, inwardly.

There may be more efficient methods of learning information, but when Amy's mother came for her after school and asked if we had gotten enough bottles, the response she received from her daughter verified the importance and the quality of learning when children do their own learning in a meaningful way.

Mother: Did you get enough bottles for baskets?

(Before teacher could say a word.....)

Amy: We need three more. We figured it out.

Teacher: Amy will tell you how she found out..........

How the Mind Works

Morton Hunt

No scientific endeavor of recent years has been more dramatic or commanded greater public attention than our exploration of outer space. In these same years, with no drama whatever and almost no public notice, a small band of researchers, now numbering perhaps a thousand, has been exploring inner space - the universe within our minds, where in words and images we make a working model of what lies outside.

These researchers are practitioners of a new discipline called cognitive science, an amalgam of psychology, psycholinguistics, computer science, psychobiology, anthropology and philosophy. They are investigating how we construct that inner universe and then how, by tinkering with it, we know what to expect of the world outside - in short, how we think. Their endeavors were characterized by a participant at a cognitive-science seminar organized several years ago by the Alfred P. Sloan Foundation in New York City (a major backer of the new discipline) as "the start of an intellectual adventure somewhat comparable to the position in which physics stood toward the end of the Renaissance."

Cognitive science is still far from being a coherent and integrated body of knowledge. Often, indeed, the members of this new discipline are quarrelsome and at odds with one another - a trait that Thomas S. Kuhn, the philosopher of science and author of "The Structure of Scientific Revolutions," has said is typical at this early stage of development.

For what is happening is nothing less than revolutionary. From the 1920's until about a decade ago, the human mind was out of fashion, scientifically speaking, and ignored by most American psychologists on the ground that theories about what happens within it are both unverifiable and unnecessary.

Such was the view of behaviorism, the theory that dominated academic and research psychology for half a century. (Freudian psychology, though inward-looking, reigned supreme only within the psychotherapies and, in any case, dealt more with emotional processes than with thinking.) Behaviorists held that the scientific approach to human behavior was to observe the relationships between the external stimuli and the observable responses; if, knowing the former, one could predict the latter, there was no need to speculate about what took place, unseen, within the mind. Indeed, they viewed such speculations as benighted; B.F. Skinner, the dean of contemporary behaviorists, has said that efforts to explain human behavior in terms of what goes on in the mind are akin to primitive animism - the belief that spirits dwell in material objects.

This disesteem of the human mind has had numerous parallels elsewhere in American life - in the behavior therapies that treat patients by methods not unlike those of animal trainers; in the doctrine of certain animal-behavior specialists that we are only naked apes, ruled more by primitive neural structures than by the thinking forebrain, and in those many movements that celebrate feeling and mystical experience while denigrating the intellectual and reasoning.

Cognitive scientists, in contrast, hold that the human mind is highly complex and thoroughly admirable, that one cannot understand human behavior without knowing what goes on in it and, most important, that it can be scientifically investigated. They share a heady sense of excitement at devising new techniques for finding out how the mind works, and they are beginning to derive a series of richly explanatory theories about it.

Already, in fact, their ideas and findings have reverberated throughout American life. In the universities, cognitive theory is rapidly displacing behaviorism as the guiding viewpoint of psychology. More than a hundred institutions of higher learning how offer courses in how to think better, based on recent research in problem solving and creativity. Behavior therapies remain popular, but most behavior therapists are supplementing their treatment techniques with a goodly dose of "cognitive therapy" - the exploration of the misperceptions and distortions of thought that cause inappropriate responses to what other people say and do. Articles on various aspects of cognitive science appear frequently in professional journals and popular science magazines, either arousing or responding to (or both) a new interest on the part of the reading public in how the human mind functions.

Cognitive science has had this much impact because it shows that, while the mind's processes cannot be directly observed, they can be explored by means of circumstantial evidence. Even as physicists cannot see electrons, muons or other subatomic particles but infer their properties from the tracks they leave in a cloud chamber, so cognitive scientists deduce the nature of the mind's machinery from what happens to information fed into it. Here are some recent experiments that, like cloud chambers, reveal the tracks of thought:

In a classroom at the University of Washington, the experimental psychologist Elizabeth F. Loftus recently showed a group of student volunteers a brief videotape of eight demonstrators bursting into and disrupting a class. Afterward, she asked half of her subjects, "Was the leader of the four demonstrators a male?" Speaking to the other subjects, she replaced "four" with "12." A week later, she asked all of them how many demonstrators they had seen: The answers of the "four" group average 6.4, but those of the "12" group averaged nearly nine. Dr. Loftus concluded that, in those kinds of situations, we do not retain both our original memories of events and subsequent information or misinformation about them, but that the original memories are amalgamated with and revised by later influences. Even under hypnosis (as she and others have found in experiments), the original experience exists nowhere in memory; we possess only the end product.

In a laboratory at the University of Pennsylvania, a 3-year-old girl watched as the child psychologist Merry Bullock demonstrated a Snoopy jack-in-the-box, a broad, flat wooden chest. Dr. Bullock put a steel ball in a hole toward one side of the top. It rolled down a slanting runway, visible to the child through a plastic front panel, and then disappeared: a second later, a Snoopy doll popped up from the top of the box in the direction the ball had been headed, as if triggered by it. After the little girl had watched this performance several times, Dr. Bullock pulled the box apart (it was made in sections); now the ball rolled down in the first section and disappeared, but the Snoopy doll in the central section, secretly activated by a button, continued to jump up, though the ball could not possibly have got to it. The little girl burst out laughing and wriggled around in her chair. Dr. Bullock asked her what had happened. "I don't know!" she said, hunching up her skinny little shoulders. At 3, she was too young to talk in terms of cause and effect or to understand such words, but her surprise at seeing a bizarre and seemingly uncaused event was evidence to Dr. Bullock that the human mind is built so as to connect events casually long before it can deal verbally with that sophisticated concept.

In a psychology laboratory at the University of Texas at Austin, a student volunteer sat before a small video screen on which pairs of words appeared; his task was to decide as quickly as possible whether each pair belonged to the same semantic category. On came these two:

LION
HORSE

and he pushed a button indicating he thought they were "Same." Then on came these two:

LION
APPLE

and he indicated: "Different." In each case, it had taken him about three-quarters of a second to respond. Now the experimenters, Philip B. Gough and Michael J. Cosky, flashed on the screen a single word (PEAR) and added another word (APPLE) less than a second later. "Same," answered the student -- about a fifth of a second more quickly than before. The difference, though minute, struck Gough and Cosky as extremely significant. They were trying to deduce the steps by which we understand words we read and had hypothesized that before a word can be understood it must be carried from the retina to a part of the brain where it is briefly retained while we look up its meaning in our memory bank of words. If one word of a pair is shown to us first, we should be able to look it up before the second one comes along; thus, the time needed to decide "Same" or "Different" when the second word appears should be a trifle shorter than if both appear at once. And that is exactly what they found. In such a note of fact, a large principle can be discerned: We "process" incoming information step by step, and what those steps are can be inferred from the different amounts of time it takes us to do slightly different tasks.

In scores of laboratories, cognitive scientists use "protocol analysis" to deduce how the mind goes about the business of solving a problem. The subject is presented with, say, an end game at chess or a problem in cryptarithmetic (a mathematical puzzle in which digits have been replaced by letters: the task is to break the code). Or it may be a real-life problem: Several researchers have been confronting physicists, physicians, lawyers and engineers with the kinds of situations they deal with in their professional capacities. The subject is asked to say out loud everything he or she is thinking while solving the problem. Then the protocol (the transcript of these utterances) is analyzed, step by step, to show how the subject generated various hypotheses, made tentative forays in this or that direction, backed away from unpromising avenues or blind alleys of thought and so on. The subject, to be sure, voices only conscious thoughts -- a small part of what is going on -- but from these traces the analyst conjectures what was going on in the subject's unconscious -- for instance, whether he or she was proceeding chiefly by trial and error or on the basis of stored information and how he or she was choosing which of several alternatives to try first. The subject's total set of operating procedures can then be written out in the form of a computer program and actually run on a machine. If the machine deals with the problem much as the human being did, the researcher's overall analysis is confirmed.

At the Center for Human Information Processing of the University of California at San Diego, David E. Rumelhart has lately been telling rather dull little stories to both children and adults. One such story begins: "Mary heard the ice-cream truck coming down the street. She remembered her birthday money and ran into the house." At that point, Rumelhart stops and asks his listeners what is happening; most of them recognize that Mary is a little girl, wants ice cream when she hears the truck and goes into the house to get money for it. Isn't that obvious? Yes, but where in the two sentences is any of these things actually said?

Rumelhart is looking into the way we understand one another's communications; we do so, he and others are discovering, not just by hearing what people actually say but by making a set of inferences, drawing upon our own extensive knowledge of the world, to supply what is missing. The speaker or writer can count on us to come up with the right stuff, because knowledge in the memory network is "packaged" in stereotypical routines or clusters of well-known cause-and-effect relationships. (Think of all that is mutually understood in the exchange, "Yeah?" "Yeah." "Oh, yeah?" "Yeah!"

Long before the first stirrings of the cognitive-science revolution, many psychologists had been troubled by the inability of behaviorism to explain a number of aspects of human behavior. Memory was a case in point. Behaviorism dealt with it as if it were all of a piece: The organism remembers best what has been most often repeated, best rewarded and so on. There was a nice clarity and precision to this explanation; it was even turned into algebraic equations. But while the equations fit most laboratory observations of rats and other animals, they did not fit everyday human experience, which offers abundant evidence of two distinctly different forms of information storage — short-term memory and long-term memory. We look up a telephone number for the 20th time, repeat it to ourselves half a dozen times until we dial -- and promptly forget it again. Yet much of what we have experienced only once remains long or permanently in a memory: the price we paid for a book, a joke we found particularly funny, a special look on someone's face. Repetition and reward are not a good enough explanation of learning; internal cognitive factors -- such as meaning -- play a part.

Language was another area that cried out for explanations involving complex mental mechanisms rather than simple rote learning. Children do imitate the speech they hear, but they do a lot more than that. As the linguist Noam Chomsky pointed out in 1959 in a withering critique of behaviorist theories of language acquisition, children produce all sorts of sentences they have never heard before. They create new sentences out of words they know, guided by some internal sense of syntax. So do adults; every day each of us utters sentences he has never heard or read. Clearly, a lot does go on inside and needs to be taken into account.

By the late 1950's, many such observations had caused pressure to build up among psychologists for a new effort to explore the human mind. At the same time, a number of coincidental developments in related fields of study were yielding insights into various aspects of mental functioning and furnishing a wealth of bits of evidence about such thought processes as visualization, concept formation, logical reasoning, language comprehension and problem solving. But each process seemed to have its own rules; what was lacking was some unifying principle.

About two decades ago, such a principle began to emerge from information theory and computer science. What a computer does from first to last is process information: It transforms punched-in letters into digital bits, routes these to where they can be recognized or stored, retrieves them as needed, puts them to work according to the program and the operator's commands, and eventually changes them back into a readable display on a screen or on paper.

A few psychologists -- among them, most notably Herbert A. Simon of Carnegie-Mellon University -- saw by analogy that the mind, too, was engaged in information processing; that was the overall function of the separate mechanisms working within it.

If, for instance, you read the question "What is the largest number that will go into 100 an odd number of times (and more than once) with no remainder?" you turn the perceived shapes of the letters and words into neuronal impulses; then you compare them to stored shapes, sounds and meanings in memory to identify them and decode the sense of the sentence; then you reason about how to find such a number, try the numbers suggested by the method you chose and find one that works; and finally you check your work. Each of these steps is part of an information-processing program. (The answer, of course, is 20.)

Cognitive science is thus concerned with a system of processes for manipulating information; it is this concept that has come, in recent years, to unify and guide the new field.

(Brian research, though associated with cognitive science, deals with very different matters -- the electrical impulses or chemical signals, for instance, produced by individual neurons. Thought processes are the highly organized product of millions or billions of these microevents: cognitive science is concerned with the principles governing these higher-level structures, much as the study of waves is concerned with wave mechanics and not the motions of water molecules.)

The practitioners of this new discipline sometimes betray an attitude that seems unusual for scientists: They are often awed by what they are studying. They rarely say so out loud, perhaps fearing to sound insufficiently objective, but one can read that message between the lines of their congested technical prose.

Occasionally, though, some cognitive scientist will actually come out with it. Professor Rochel Gelman, who specializes in childhood development at the University of Pennsylvania, said recently, "The human mind, as I see it in my work, is a wonderful, a magnificent structure created by evolution. Nothing resembles it or comes close to it." Elliot Soloway, an artificial-intelligence researcher at Yale, painstakingly worked out a computer program a while ago that could figure out some of the simpler rules of baseball by watching a game being played. (It "watched" by ingesting a series of numbers and symbols representing the physical movements of the players.) Soloway's aim was to test his ideas about how human beings make sense of their experiences. "The more I worked on it," he says, "the more I was amazed that people can understand *anything*. It's really very hard to make sense of the world -- and yet we do. Even little kids do. It just blows me away!"

When cognitive scientists reckon the information capacity of the human memory, they come up with numbers such as 10^{11} (100 billion) bits of information, a fact they are likely to offer, at least in writing, in the calmest of tones. (The average adult's memory thus holds at least 500 times as much information as the entire Encyclopaedia Britannica.) But when they speak informally, they may let their feelings slip. One specialist in memory research said to me, "You couldn't fit into the biggest computer now available all what a 4-year-old knows about his mother's kitchen — the properties of the furniture in it, what things will spill and when, what actions will yield what results and so on, and on." He shook his head wonderingly.

But what is even more notable than the capacity of our memory is our ability to find what we need in it. To retrieve a fact from a card file or a computer, you have to know how to locate it; if you don't know how it has been classified and filed, it may as well not exist. The human memory, in contrast, is organized not just alphabetically, numerically and topically but in innumerable ways; items in it, research shows, are arranged in interlacing networks, with the result that practically any word, image or other memory can be reached from any one of many starting points by a vast number of routes.

We are aware of that when we try to think of a forgotten word -- we may cue ourselves with the first letter, or its general sound, or its meaning, or a mental image of the last time we heard it used or some other connection. Usually, though, we need not make a conscious effort; words are available to us as fast as we wish to utter them. Artificial-intelligence researchers are envious of this human ability. As Hans Berliner at Carnegie-Mellon University put it, "Human beings can store large amounts of knowledge -- and get at it.

Computers have a lot of trouble doing that." He paused, and then added, "In fact, the problem of having a computer find its way around in its memory" -- as a human being does -- "is pretty close to hopeless."

Research in problem solving similarly offers many opportunities to be impressed by the machinery inside the head. Professor Paul E. Johnson of the University of Minnesota is one of the researchers who have been investigating how experts in highly technical professions solve their problems. They do so, he finds, not by an orderly and stepwise method, as in solving a puzzle or playing a game, but by a far more complicated, hard-to-fathom, yet efficient, method.

For instance, a cardiologist, presented with a fragmentary case history as a problem in diagnosis, is likely to break in with a correct answer after hearing just a few scraps of data. At that point, according to Johnson, "We say to him, 'How did you know? With only three pieces of data, how could you possibly know?' And it turns out he doesn't really know, but he has a good hypothesis, based on experience and knowledge special to this domain, that consists of shortcuts and tricks. But the expert can't tell you how he does what he does. As he was growing proficient, he had to think about what he was doing, then he went through a phase where he was practicing these hookups, and finally he got to the stage of automaticity, where all that stuff is filed away out of sight. So he says, 'You can't reduce diagnosis to rules. It's an art -- I just do it.'"

"What he can't tell us -- but what we're finding out -- is that he's doing top-down and bottom-up thinking at the same time. He's seeing things in a general way but also in a highly specific way, using his tremendous network of experimental associations and relying on his intuitive judgments." Then, beaming, Johnson exclaims, "In our solving of problems, we're not logical machines, we're psychological machines!"

All of these issues are what cognitive scientists often refer to as "interesting questions." They use that term in a special sense to mean issues that are not just attention-getting but important, not yet fully understood and, above all, difficult to deal with.

Every science has its own similarly interesting questions, but cognitive science is willing to take on -- indeed, by its nature cannot escape -- ideas that have intrigued and puzzled thoughtful people through the ages.

One of them is the ancient nature-nurture issue. One doctrine, dating back at least to Plato, holds that our minds come equipped with innate ideas or, at any rate, inherited tendencies to think and behave in very specific ways. The opposite doctrine, held by the behaviorists and their philosophical predecessors the empiricists, maintains that the mind is a blank slate at birth and comes to think only in ways that have been written upon it by experience and training.

Cognitive science has been turning up a good deal of evidence that both sides are partly right and largely wrong. Recent research suggests that our minds come equipped with highly efficient neural arrangements built into us by evolution; these predispose us to make certain kinds of sense of our experiences and to use them in that distinctively human activity we call thinking. It is the product of an interaction between nature and nurture; each is essential, neither is wholly controlling.

This is abundantly evident in the studies of language acquisition by children. It is experience that causes children to learn the language they hear -- yet they would learn none were it not for the built-in machinery that prepares them to reproduce what they hear and that enables them to make order out of the verbal chaos around them.

Babies begin to babble at 3 or 4 months of age, and their babbling increases until they start to form understandable words, at which point it decreases. Parents naturally take the babbling to be an attempt to imitate adult speech, but they are wrong: Studies of deaf children show that they, too, babble. Evidently, it is a spontaneous, hereditary activity that begins when the neural centers directing it have reached a certain stage of maturation. It is a necessary preliminary to speech, and in normal children it changes and increasingly comes to include the sounds of the spoken language. In deaf children, however, it dwindles away from lack of feedback. Here, then is evidence that both nature and nurture are involved in human mental development -- not X percent from one and Y percent from the other, but the two interacting to produce the result.

Another way in which our minds are predisposed to organize the welter of incoming experience is by recognizing patterns in the events around us. Even the tiny child is captivated by the meter and rhyme of verse and will respond to strong musical rhythm by dancing. We build on that inherent capability. A third grader, without being told what to look for or why, will notice the ways the numbers are changing in this simple problem and solve it without trouble:

What number comes next?

2 3 5 6 8 9 ---

An adult, with much more experience, can handle far more complicated problems, such as this one:

What are the next letters?

A B R S Z B C T U Y---*

Our native sensitivity to patterns accounts for a great many human discoveries -- everything from primitives' recognition of the cycle of the seasons to present-day astronomers' perception of the way the galaxies are

---

***The answer is C D V W X**

dispersed throughout the universe.

We human beings, moreover, are concept-making creatures: Unlike any other animal, we have a natural ability to group objects or events together into categories, give them abstract labels and so think about the world in a highly efficient way. The interesting aspect of this question is how we acquire the concepts by which we do our higher-level thinking. No doubt we acquire most of them from other people: The parent explains to the child that "animal" means cat, dog, mouse and the like; the professor explains to the student the meaning of significant correlation or, perhaps, romantic love. But a number of recent studies indicate that the human mind is capable of forming categories on its own, without outside help. Researchers showed 1-year-olds slides picturing pieces of furniture, two at a time. After a long series of such slides, they switched to one showing an item of furniture and a face; almost always, the child would look at the face rather than the piece of furniture. But if they showed a series of pairs of faces first, then a slide of a face and a piece of furniture, the child would prefer the latter. Apparently even a 1-year-old child is able to categorize the objects he or she sees and takes more interest in something from a new category than from an old one.

Recently, at the Human Performance Center of the University of Michigan, the cognitive psychologists Lisbeth Fried and Keith Holyoak made up a number of slides of abstract geometrical patterns. They had started with two somewhat similar basic designs and, on a computer, generated a number of variations that differed from the original in varying degrees. Then they told a group of volunteers that they would be seeing designs by two minimalist artists and were to try to distinguish the work of one from the other -- that is, sort them into two groups.

As the designs were projected one by one, the volunteers made a choice by pushing one of two buttons. The researchers told some of them whether each choice was right or wrong as they made it; not surprisingly, these people quickly got better at the job. The researchers told the others nothing -- yet this group, with no corrective feedback got better at the job virtually as fast. Drs. Fried and Holyoak concluded that our minds file away incoming experiences in such a way that similarities overlap and we shortly perceive what is typical in a group of related things. We automatically create and refine.

Once again, therefore, it appears that, as one cognitive scientist put it, "We're hardwired to make certain kinds of sense out of the world." ("Hard-wired" is a computer-science term that refers to built-in traits, resulting from fixed circuitry rather than programming.) Unlike the lower animals, we human beings have very few specific behavior patterns built into us; we are not constrained by our hard-wiring to eat only certain foods, build only one kind of shelter or make love in a single fashion. But we are constrained by our mental hard-wiring to make certain kinds of order out of our experiences. Constraints, however, are not always limitations; they can also be capabilities -- and those that are built into the human brain are our greatest asset, for they force us to construct the human intellect.

Another classic question that cognitive science is looking into is the matter of whether the human mind arrives at knowledge by means of logical reasoning or in some other fashion. Every since Aristotle's time, many philosophers have thought that deductive reasoning was the road to truth. In our own time, the immensely influential psychologist Jean Piaget maintained that logic was the natural mode of human reasoning and that every child inevitably developed logical reasoning by the early teens. Not every parent would agree.

Cognitive scientists have more cogent reasons for thinking that logic is not the normal mode of human thought. For one thing, in logic every statement is true or false, but in real life many statements are neither. If someone says, "John's wife is sick," and in fact John is unmarried, the statement is simply irrelevant, a condition the mind recognizes but logic does not. Again, with logic we can derive innumerable valid but useless inferences from any true statement -- and nothing within the system of logic guides us to avoid such inferences. (For example, if it's true that "Roses are red," then it's equally true that "It isn't true that either roses are red or they aren't red.")

More to the point, the evidence shows that our "natural reasoning," as cognitive scientists call it, proceeds by quite other means. In everyday life we reason most of the time by noting similarities between things, making good guesses and reaching conclusions on the basis of likelihood or probability rather than logical certainty.

The psychologist Allan Collins, senior scientist at the Cambridge, Massachusetts consulting firm of Bolt Beranek & Newman Inc., has spent years studying natural (or, as he calls it, "plausible") reasoning. He has tried a number of little problems on various subjects and asked them to talk out loud while thinking the problems through. From their answers, Collins has identified hundreds of common kinds of plausible inferences -- the fundamental forms of everyday reasoning -- one of which actually consists of reasoning not from knowledge but from the lack of it. "Is the Nile longer than the Mekong River?" he asked, and one young man said he thought it was, because in junior high school he read a book on rivers, and he remembered reading about the Nile and the Amazon but not about the Mekong. He was saying, in effect, that because he didn't know whether or not it was long, it probably wasn't.

Most of our plausible reasoning relies on the intuitive recognition of similarities or analogies between two things. "We reason analogically," says Robert J. Sternberg of Yale, "whenever we make a decision about something new in our experience by drawing a parallel to something old." In most cases, the reasoning is invalid by strictly logical rules -- but intuitively we know better. And most of the time we are right; were it not so, we would long since have become extinct.

A very old example of such reasoning is Virgil's story of how Dido founded Carthage: She was granted as much land as she could enclose with an ox hide -- which she cleverly cut into long thing strips and laid out as a circle, the largest area that can be enclosed by a line of given length. But how did she know that was the optimum shape? Intuitively, no doubt, based on analogy with such similar experiences as tying as many sticks as possible into a bundle with a piece of string.

A more recent example: A couple of years ago at M.I.T., I was talking to the physicist Andrea di Sessa, who had been studying how high-school and college students think about physics problems. He diagramed on his blackboard a pulley with a rope running over it and down each side; at one end of the rope he drew a monkey and at the other end, a box representing a weight. The two weighed the same, he said. Ignoring friction, what would happen to the weight if the monkey climbed the rope?

Grasping at a straw of thought, I said, "Well, the energy he expends has to go someplace, so I guess the weight rises as high as he climbs."

"That's right, it does," said di Sessa. I felt pleased. "And many students get the right answer," he went on, "but can't explain how they got it -- or, like you, get it right for the wrong reasons." I felt less pleased. (The problem concerns the laws of motion: Since the forces acting on the two objects, both initially at rest, are always equal, their motions must be. Viewing the problem as one of the conservation of energy, as I did, may lead to the right answer but ought not to.)

Creativity -- in the arts or any other area -- is yet another classic issue that is gaining scientific respectability, thanks to cognitive science. Until recently, the investigation of creativity was carried on by a variety of dabblers from the arts and assorted sciences, plus a handful of non-behaviorist psychologists. Some of them devised tests that identified who was creative -- but not why they were or how they managed to do what they did. Others collected accounts of creative experiences that entertained but hardly explained. A famous example: The 19th-century German chemist Friedrich Kekule had been laboring long, and in vain, to figure out the structure of the benzene molecule. Exhausted, he sank into a reverie, staring into the fire, when a vision came to him of a snake biting its own tail and he realized that the core of the benzene molecule was a ring of carbon atoms. But how or why this vision came to him he could not say.

Much of the older writing about creativity seems to regard it as describable but ineffable -- an almost magical or spiritual act. Cognitive scientists, in contrast, regard it not as something unlike the rest of cognition but as a special kind of problem solving -- the kind that yields answers to new problems, or new answers to old ones. (The question of to what degree creativity takes place in the right brain rather than in the left brain is not of much interest to cognitive scientists. The real question, they feel, is how the brain, whatever half is involved, comes up with new ideas.)

One current approach to exploring creativity uses protocol analysis: John R. Hayes and Linda Flower, at Carnegie-Mellon University, have been asking subjects to voice all their thoughts while writing an essay. From the analysis of the trains of thought thus captured, Drs. Hayes and Flower have been able to portray the steps involved in writing in the form of a flow chart containing a score of little boxes (each box represents a mental function) connected by arrows. It seems to indicate that creative work, at least at the conscious level, involves a far more orderly set of procedures than many artistic people like to think.

New ideas, however, pop into this system from the unconscious, an area the chart leaves unmapped thus far. How or when the unconscious is at its most creative is still largely conjectural, but other studies suggest that one important condition is that the goal of the problem be "ill defined" -- that is, general, not specific. If a ship designer, for example, defines his goal as the more economical use of fuel in cargo vessels, he will fidget with and improve the boilers, the propellers and the hull shape. But if he defines it as moving the boat through the water more cheaply, he may be freed to think of going back to wind power, using mechanical sails, as the Japanese and others are beginning to do.

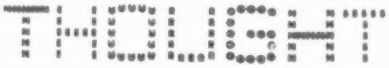
But loosely defining the goal will not help unless, at the same time, the mind is packed with pertinent information. Current problem solving research, Hayes told me, stresses the relationship between knowledge and creativity. "Take that famous figure," he said, "worked up by Herb Simon, that the chess master has learned and stored in memory 50,000 patterns of positions on the board. What that says to me is that to generate creative answers to problems, you need many years of experience and hard work and a lot of information. We have studied composers' lives, and I claim that the magic number is 10 -- that is, 10 years between the time a composer starts intensive study and the time the first notable compositions appear. It was true of Mozart, Mendelssohn, Schubert and others -- I have a sample of 76 -- but, of course, that amount of time and effort is only a necessary condition, not a sufficient one. There are innumerable poor slobs who can spend the same amount of time and effort and still not produce a creative work of any magnitude."

Finally, several researchers have noticed that the human mind seems most capable of creativity when motivated, not by the hope of reward, but by the intrinsic joy of finding new answers to a problem. In one typical study, a group of students were told that they would earn a reward for thinking up the largest number of titles and plots; a second group, not promised any payoff, proved to be more imaginative and original than the first. Highly creative people, of course, hope for financial and social success, but one student of creativity, Dr. Teresa M. Amabile of Brandeis University, suggests that they may be able to shut out the thought of reward while working. In any case, the findings imply that most of us are at our most creative when playing with ideas for the sheer pleasure of it rather than out of need or greed. It is one of the paradoxes and splendors of the human intellect.

Perhaps the most intractable of the old problems of the mind has been the question of the homunculus, a term representing the illusion that there is a little person, a tiny someone, inside -- a fallacy that Sir Francis Crick says is all too easy to slip into. Sir Francis, co-discoverer of the double helix, who now is doing research in neurobiology, wrote in a recent Scientific American that he was trying to explain to an intelligent woman why it was puzzling that we perceive anything at all: "She could not see why there was a problem. Finally in despair I asked her how she herself thought she saw the world. She replied that she probably had somewhere in her head something like a little television set. 'So who,' I asked, 'is looking at it?' She now saw the problem immediately."

This is, in fact, not one problem but two. The first is philosophy's ancient puzzle about mind and body. The homunculus is a symbol for something other than brain inside the brain -- something incorporeal, a bodiless watcher and operator of the mechanism. There are, of course, serious difficulties in the ancient dualist position that mind or spirit exists apart from body or material things. Most cognitive scientists are untroubled by these difficulties because they simply do not believe in incorporeal substance. And for good reason: In science, a theory is not considered worthy of belief unless it can be put to tests that would prove it false if it were, indeed, false. The theory that the earth is round, for instance, is falsifiable, but the tests that might falsify it do not do so; that makes it credible. The assertion that unicorns exist is not falsifiable -- what test could disprove that claim? -- so is unworthy of belief. The same is true of the notion that mind is a separate form of existence, apart from body.

But if mind is not an incorporeal something, what is it? The general answer of cognitive scientists, drawn from modern philosophy, computer theory and information theory, is that the thought processes that make up the mind are organizations of millions and billions of neural events; these organizations are higher-order events or entities known as epiphenomena. A flame is the composite organized effect of innumerable chemical events at the molecular level. To clarify this thought, here is a simple example of an epiphenomenon (my thanks to Douglas R. Hofstadter, from whose book "Godel, Escher, Bach" I borrowed the idea):



Now to the second problem: How can this epiphenomenon, mind, be conscious of itself? A lens is used to see other objects, but it cannot see itself: if the mind is made up of thought processes, how does it manage to perceive itself? If it consists of thoughts, how can it experience itself as something unique? Whence comes the "I" that is unarguably real to each of us? This entrancing and murky subject, long considered fit only for philosophers, is now given serious consideration by cognitive scientists, at least at the level of hypothesis if not experiment.

Some of them say that consciousness of self is an interaction effect -- it is what happens when one part of the mind interacts with another: an epi-epiphenomenon, so to speak.

Others say it is a feedback effect -- what Hofstadter calls a "strange loop of the mind," a self-reinforcing resonance. "The self," he writes, "comes into being at the moment it has the power to reflect itself." We are aware of our thoughts, but the awareness is itself a thought and the foundation of consciousness.

A somewhat different way of saying much the same thing comes from child-development studies. As the child grows, it becomes aware of two worlds -- the one outside and the one within. Throughout life we continually experience the difference: We see the face across the table, but we can also see it in the mind's eye -- and recognize which is which. It is this experience of both the outer world and out internal version of it that results in our awareness of ourselves.

Thus has Descartes' fundamental premise, "I think; therefore I am," been translated into contemporary terms and philosophy been put back into science.

(This article was reprinted from the New York Times Magazine, January 24, 1982)

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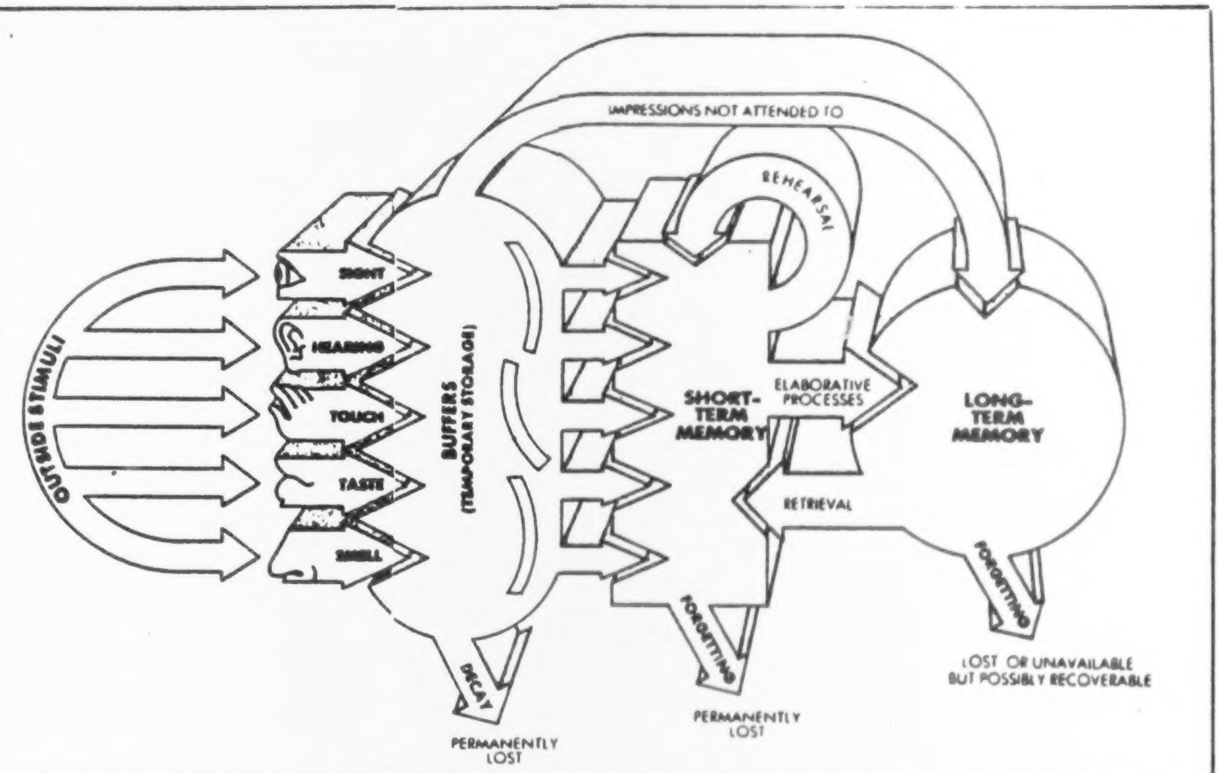

IMPRESSIONS NOT ATTENDED TO
REHEARSAL
OUTSIDE STIMULI
SIGHT
HEARING
TOUCH
TASTE
SMELL
BUFFERS (TEMPORARY STORAGE)
SHORT-TERM MEMORY
ELABORATIVE PROCESSES
LONG-TERM MEMORY
RETRIEVAL
DECAY
PERMANENTLY LOST
FORGETTING
PERMANENTLY LOST
FORGETTING
LOST OR UNAVAILABLE BUT POSSIBLY RECOVERABLE

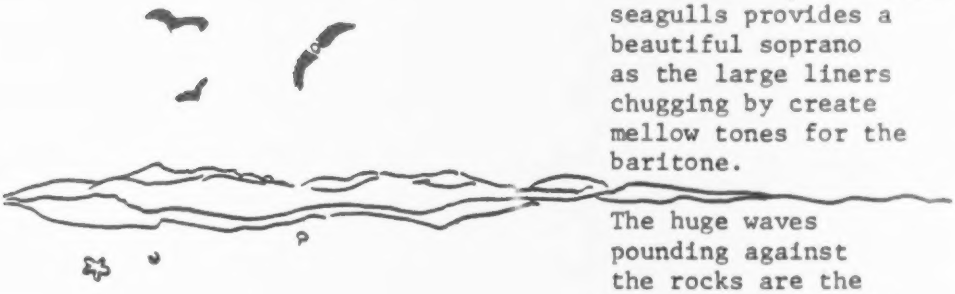
MEMORY AS INFORMATION PROCESSOR: *This conceptual model shows how some cognitive scientists believe memory works. The senses send information to a temporary storage, or "buffer," zone, where the mind selects what to notice. Some selections move into short-term memory, where, after "rehearsal" (repetition), they are used and soon forgotten. A few impressions go directly into long-term memory, but most of what is remembered must undergo "elaborative processes" that classify and link new information with previously stored material.*

* * * * * * * * * *

Le Symphonie

Listen now as I
play the music
of the beach on the
phonograph in your mind.

The faint cry of distant
seagulls provides a
beautiful soprano
as the large liners
chugging by create
mellow tones for the
baritone.



The huge waves
pounding against
the rocks are the
percussion, setting
the beat on the
phonograph in your mind.

--Richard Emling

How Many Dogs Are There in Town?

Betty Bledsaw

In one of Dr. O'Brien's Solve It books, there is a problem solving page involving dogs. I like dogs and I know children like dogs so I picked this activity.

I interviewed one first grader, one second grader, one third grader, two fourth graders, two fifth graders, four sixth graders and three adults. Listed below are the results of the interviews.

First Grader (7-4) His first reply was "I don't know." I waited awhile to see if he could come up with something else. Finally he said "I'd go house to house and ask how many dogs there are." (A side comment: After I interviewed him, the other first graders in his class wanted to do it, so I asked them. The answers ranged from "I wouldn't want that job" to "I'd pray every night to God and maybe some night he'd tell me.")

The first grader further went on with his explanation. It went like this: "If there weren't any dogs, I would ask how many cats there are. Cats and dogs aren't alike, you know. A cat is kinda like a dog and you can pick up the dog, the same way you do a cat."

Second Grader (8-0) "I would go to each person's house to find out how many dogs they've got."

Third Grader (8-11) The girl sat for quite awhile thinking. She never did volunteer any answer. I finally asked her again. She at last said, "I would go on my street and go to those houses and see how many dogs there are."

Fourth Grader (9-9) "I would go to the vet because he knows more about animals."

"Why and what would he know about the dogs?" I asked. (Interviewer)

"Because he knows how to take care of them."

Fourth Grader (9-11) "I would go to the City Hall and check the files and check how many dogs are listed there. I would check the registration and the dog tags list. I would check the places that send out dog food. I would find out where it goes."

Fifth Grader (10-1) "I would go to the police department and find out how many dog tags. I would go to the dog pound and record all the dogs in the vicinity. Ask the mayor if he knows how many there are."

Fifth Grader (10-0) "I would check the ads of how many dogs are for sale and how many get sold. I'd also check how many were also being sold from Glen Carbon. Then I'd ask the mayor if he could check with the people who work with dogs and how many they have seen. I'd count the dogs in a certain area and then multiply that times the square feet of Glen Carbon."

Sixth Grader (11-8) "Go to the dog pound and see how many dogs have been turned in that are not wanted. Ask people in the neighborhood if they have a dog."

Sixth Grader (11-7) "Call around. Call all the people. The long way would be to count them." (He didn't explain this.)

Sixth Grader (12-1) "Call the dog pound and record how many there were. Ask the vet how many shots have been given to dogs. Ask door to door."

Sixth Grader (12-2) "I'd ask my friends. After all, we know everybody. They could ask their friends and those could ask their friends. I could call the dog license office and see how many dog licenses were sent out."

Adult #1 "Check with the city government -- What do they think about this? Contact and talk to the vet. How many has he seen or taken care of? Do a door to door census. Ask the rabies control how many shots have been given. Check with the license bureau. How many dogs are registered?"

Adult #2 "Take the population of the town and multiply by ½. Some houses don't have dogs, and some have two or more dogs. Almost every house has a dog.

Adult #3 "Count the number of cases of dog food sold in town. Check at the license office to see how many paid dog tax. Go to the vet and ask him.

Readers, scan the interviews to see if you can see some developmental trends (differences in amount of information given by the children). Which one statement appears in almost all the interviews and which interviews get at the problem of proportionality.

Try an interview. You'll learn a lot!

* * * * * * * * * *

Square Surgery

Barbara Grigg

Using 8 squares, try these eight challenges. (Use graph paper)

1. Make 4 congruent squares.
2. Make 16 congruent squares.
3. Make 2 congruent triangles.
4. Make 4 congruent triangles.
5. Make 3 triangles.
6. Make 6 congruent triangles and 1 square.
7. Make 2 congruent triangles and 1 parallelogram.
8. Make 4 congruent parallelograms and 8 congruent triangles.

What Are We Teaching When We Teach Multiplication?

Joyce Goodall and Shirley Casey

What do fourth, fifth and sixth grade students understand when they read a multiplication number sentence? Does their understanding consist of a simple response (the answer) or does it include more than that (what multiplication involves or a real-world example)?

In the June 1979 issue of Mathematics Teaching, Alistair McIntosh's article, "Some Children and Some Multiplications" reported an interesting research. Children aged 7-11 were given five multiplications:

1. 6 X 3 = ___ 2. 16 X 3 = ___ 3. 60 X 1 = ___ 4. 13 X 16 = ___ 5. 3 X 60 = ___

Then the children were asked to make up a story or situation which would give rise to 6 X 3 = 18.

Though this was not the complete McIntosh research, it was the portion that Joyce Goodall replicated with fourth, fifth and sixth grade students.[1] Here are the results from the computations:

	Grade		
	4	5	6
6 X 3 =	89%	100%	100%
16 X 3 =	68%	60%	86%
60 X 1 =	94%	100%	100%
13 X 16 =	0%	40%	82%
3 X 60 =	94%	86%	100%
N	19	15	23
$\overline{X}$	69%	77.2%	93.6%

The story problems that the children wrote fell roughly into six categories:

1. used 6 X 3 and set up a multiplicative situation
2. used ÷ or + to deal appropriately with the problem
3. used 6 X 3 = 18, but failed to set up a multiplicative situation

4. used the numbers 6 and 3 but set up neither a multiplicative situation nor a multiplicative computation.
5. used other numbers, etc.
6. can't tell for sure what the child understands.

The results were as follows:

	Grade		
Category	4	5	6
1.	5%	6%	47%
2.	10%	20%	13%
3.	5%	26%	0%
4.	47%	6%	17%
5.	15%	20%	21%
6.	15%	20%	0%
N	19	15	23

Since it seemed impossible to choose representative responses from the children, here are all of their responses.

	Grade 4	Grade 5	Grade 6
Category 1 Used 6 X 3 and set up a multiplicative situation.	Ruy wanted to sell cookies. His mama made 3 batches of 6. (only one question could be asked)	If there were 6 boxes with 3 pencils in each box, how many pencils would there be?	One day as Rachel was walking to the park, she saw a dog lying in the road. She ran up to him because she loved dogs. She picked him up and carried him home. When she got home, she found out that he was a a she. So Rachel named her Fluffy. After her mother said she could keep her, Rachel played with Fluffy all day. After Rachel had had her for a year, she had had 3 litters of pups, 6 pups in each one and Rachel was telling everyone that she had 18 puppies. Rachel's mother was going to make her get rid of them but Rachel showed her mom all those cute little faces and that's what changed her mind. Would it change yours? Don has a rail dragster. It takes six three gallon refill tanks to fill his fuel tank. How many gallons will go into his fuel tank? 6 X 3 = 18

			Sue has 6 kittens. Tom's cat had 3 times as many. How many kittens did Tom's cat have? One day I opened a radio and I found three capacitors. Three of the capacitors capacitated six times. How much did all three capacitate? John bought 3 Christmas cards. Each card was 6¢. How much did he spend on Christmas cards? 6¢ X 3 = 18¢ Our class had 6 chairs and 3 times that many desks. How many desks? Mr. Trent bought 6 windows and he used 3 jars of putty on each window. How much putty did he use? Tom and Jane own a ranch and they like dogs. Tom bought 3 cages of pretty dogs. There were 6 dogs in each cage. How many dogs do Tom and Jane have on their ranch? There once was a little boy named Jason. One day Jason and his Mommy went shopping and got Jason some cars. When he got home 5 of his friends came over. Jason suggested that they all play cars. Since his friends didn't bring any cars, Jason let them use some of his. Each of them including Jason got 3 cars. How many cars were there all together? Karin bought 6 packs of gum. It cost 3¢ a pack. 6 X 3 = 18¢ is what Karin spent. Marie had 6 marbles. Her brother gave her 3 times that amount. How many marbles does she have? (This child used 6 X 3 and set up a multiplicative situation, but then asked an innappropriate question).
Category 2 Used ÷ or + to deal appropriately with the problem.	Tim had 3 apples. Jill had 3 apples. Bill had 3 apples. Tom had 3 apples. Dawn had 3 apples. Karen had 3 apples. How many apples?	There were six kids on one bus. And six kids were on the second bus. And there were six more kids on the third bus. So there were eighteen kids on all three buses.	Todd had 6 dollars to spend on whatever he wanted. He went down to a store and was going to play electronic games and get something to eat. On the way, he found another 6 dollars on the ground. When he got to the store he found another 6. It must have been his good luck day. How much money did he have?
	Once there was a forest with flowers and big trees. And there was this log. And these six ladybugs in a group and another group that had six ladybugs and another group that had six ladybugs. And then there were three groups of ladybugs.	Six children are ready to eat chocolate candy bars. There are 18 chocolate bars so they divided 6 ÷ 18 = 3 candy bars each. And the children liked them so much that they wanted to do that again. Jane had six eggs. Vinny had six eggs. Bob had six eggs. Multiply and see what you get and write it down here ____.	Jenny bought 6 candy bars. She gave the candy bars to Susan next door. She went back and bought 6 more candy bars. She gave those candy bars to the girl across the street. Then she went back and got 6 more. How many candy bars did she buy in all? She bought 18 candy bars. Sue was crazy about Blue Boys Band songs. She had one record with 6 songs on it. For her birthday her friend Mary gave her a BBB record with 6 more songs on it, all of which she didn't have before. Her friend Kary gave her a BBB record with 9 songs on it, but Sue already had three of those songs. How many different BBB songs did Sue have?

Category 3 Used 6 X 3 = 18, but failed to set up a multiplicative situation.	"Mom, what's 6 X 3 = ? Please help." "OK, let's sit down. I know now it's 18." "Thanks, Mom."	Once there was a problem 6 X 3 = what. Whatever the problem was nobody knows what it is, not even a 6th grader knew what it was. So one day a new boy came to Washington. He is in the 6th grade. So the teacher asked him what it was. He said, "18". The teacher said, "You are right." This is a story problem for 6 X 3 = 18. Well, it looks easy but not for other kids. Well, you think was six threes are. Then you write it down and ask your teacher if you need help and the answer would be eighteen. Once there lived a lady with 18 cats. She was very very old and rich. One beautiful afternoon she decided to count and she thought if she had 18 cats that would be 6 X 3 = 18 and that told her that she had the same amount of cats that she always had 6 X 3 = 18. The end. Joe had 6 cars. John had 3 cars. Multiplie 6 X 3 = 18 or 3 X 6 = 18. Total 18.	
Category 4 Used the numbers 6 and 3, but set up neither a multiplicative situation nor a multiplicative computation.	There were 6 monkeys and 3 tigers. How many monkeys than tigers. Billy had 6 candy bars and Cathy has 3 candy bars. How many more does Billy have than Cathy? There were 6 lions and 3 elephants in the jungle. How many in all? Keith had three cars. Jeremy had 6 cars. How many did they have together? Jack has 6 pencils and 3 pens. How many to make 18? David had 6 trucks and he wanted 3 cars. How many have if use X ? (This child said 6 X 3 = 19) The cat went home. The cat drank three cups of milk. The cat ran away for a year. The cat came back and drank six cups of milk. How many did the cat drink? (This child said 6 X 3 = 9) Mike has 6 apples. Kim gave him 3 and Dave gave him 3 more. Sue gave him 3 balls. Angie gave him 3 books. Candy gave him 3 pencils. Julie gave him 3 plants. How many in all? There are six flowers and 3 pots.	If Jane had 3 apples, Joe had 6 apples, Tim had 6 apples and Jon had 3 apples, how many apples were there all together?	We made 6 pizzas Saturday. Then on Sunday we made 3 more pizzas. There were pepperoni, sausage and cheese flavored. How many pizzas did they make? There were 6 times the 3 camels that couldn't have no water but the others had water. There were 6 gum balls and there were 18 people. How many more gum balls do I need in all. Carl bought 6 apples and it cost 2¢. Mike had 3 times as more so they put them together. How many in all?

Category 5 Used other numbers, etc.	There was a man that sells V. He sold 16 ears of corn and 13 green beans. He add the 13 up 16 times and he sold 28. Jan had 18 cards and Jack had 2 cards = 18 X 2 = 36 Once there was a problem with the number 18. He tried to help the other numbers, but they say, "Go and play." He didn't have friends at all. Sometimes he would say "hi". They would run away. Then he seen numbers moving. He went over there and said to 17, "Do you want to play?" 17 said "Yes" and they were friends. The end!	Once upon a time there was a little boy named Charlie. Charlie likes to catch frogs. On Tuesday Charlie caught 3 frogs. On Friday, Charlie caught 3. How many frogs did he catch in all? 18 cats. 1 went away leaving 17 left. Then it came back leaving 18 in all. Once upon a time there lived 6 bears. Each of them had a black nose. There was another set of bears but each of them had a white mose. How many noses in all? 6 + 6 = 12.	Bob had 8 darts. He lost 4 and then found 6 and Mike gave him 1 and then he found 3. Now he has 18 darts. Sam had 3 bushels of apples. There are 37 apples in a bushel. He went to a farm and got 6 more bushels of apples. How many apples in all? One day I went to the store and I got 6 apples and 4 books and 8 vines of grapes. How many things did I buy? Bob was picking apples. Joe was hungry. Bob had 25 now has 23. Bob picked 12 more. How many apples does Bob have? Bob went shopping at a new store opening in his neighborhood. He had 50 dollars. He spent 40 of it and got 10 back. When he went outside, he found 8 dollars. How much did he have?
Category 6 Can't tell for sure what the child understands.	Tina had 6 $6.00 and James had 6 $6.00 and Tim had six $6.00. So if they put there mony together, how much would they have? the time is a lote math it halp you lunee a lote math so you can help other peppe so thae can lune a lote math Mom and cholte chip cooks and 6 olm.	There was an old lady who baked 6 packs of cookies. Then she baked some more 3 times. She got 18 and she had too much but she was so happy she was going to do that on every holiday. One day I was walking on White Street. I seen 6 puppies. I took them to Good's Pet Shop. Good's had 3 in a row. How many puppies did Good's Pet Shop have? Brian has three bales. I have 6 times as much as Brian does. (depends on what question would be asked).	

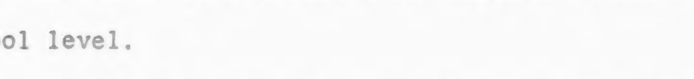
The findings above make it quite clear that fewer than 6% of fourth graders, 7% of fifth graders and 48% of sixth graders tested were able to imbed a simple multiplication algorithm into an appropriate context even though 89% (Grade 4), 100% (Grade 5) and 100% (Grade 6) were able to do the computation for that number sentence.

In an attempt to discuss/explain the findings, one can make several hypotheses:

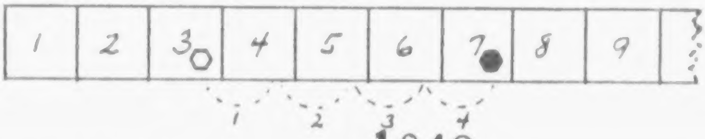
1. Children have been taught multiplication facts and algorithms as isolated entities--context-free.
2. Children have not been asked to imbed an algorithm in a real-life context.

Recently at a seminar on "Mathematics Education for the Twenty-first Century", Dr. Robert Hoecke (professor and chairman of the Department of Management Systems and Sciences at Southern Illinois University at Edwardsville)[2] forecast that computers would pervade all of education in our lifetime. He felt, therefore, that computer literacy would be required of educated people. He expressed concern about this since computer literacy requires mathematical literacy, an entity he reports to be in very short supply among university students pursuing computer studies. He reports that those students perform well in the required mathematics courses and that they can, in fact, score well on tests which measure their knowledge of mathematics vocabulary, rules, procedures, etc. But he says that these students don't know when to use this knowledge. In other words, they are not mathematically literate. McIntosh's findings as well as those reported above support Hoecke's observations at the elementary school level.

A. I. Weinzweig[3] (professor of Mathematics at the University of Illinois at Chicago Circle, member of the advisory board of the Second International Study of Mathematics and member of the International Commission for the Improvement of Teaching and Learning Mathematics) has said that since arithmetic is taught context-free, children don't see its power and usefulness. He suggests that an arithmetic fact or algorithm ought to be presented in one context and then in other contexts as well. For example, if a child has three marbles and his friend gives him four more marbles, he will then have 7 marbles. If he is playing a game on a number line and his game piece is on square 3



and he rolls a ⚃ on the die which tells him how many spaces to move, he will end up in space 7.



With several such experiences in different contexts, the child will begin to appreciate the idea that three of anything added to 4 of the same thing will be 7. This, for children, is quite different than memorizing 3 + 4 = 7.

Footnotes

1. Joyce Goodall teaches at Washington School in Belleville, Illinois.
2. Hoecke, Robert, "A computer scientist looks ahead", presented at a conference entitled "Mathematics Education in the Twenty-first Century", held at Southern Illinois University at Edwardsville, December 9-10, 1981.
3. Weinzweig, A. I., Learning and Context, a paper published by and available from The Teachers' Center Project, Southern Illinois University at Edwardsville, Edwardsville, IL 62026.

* * * * * * * * * *

Just A Match

________________FLASH!!!
Burning.
Edging. . .closer. . .closer.
LIT!!!
Tossed carelessly out of sight.
Darting toward the grass
with raging hunger!
________Reaching endlessly,
Charring, scorching, mutilating!
Grabbing everywhere, more, more, MORE!
_______But no one realizes. . .
until someday. . .

-- Gary Huels

Children Learning Multiplication

Thomas C. O'Brien and Shirley A. Casey

INTRODUCTION

This investigation had its beginnings in a report by McIntosh[1] in which children at age 7-11 were asked to complete some multiplication computations, then to make up a story situation which would give rise to one of the computations, 6 x 3 = 18. McIntosh reported verbatim a small sample of the children's stories and concluded, "The idea of multiplication is not easy; addition is much simpler. Many children confused the two in stories even when they performed the computation correctly. Several teachers reported that young juniors were quite unable to produce situations requiring multiplication..."

McIntosh's research was replicated in part by Goodall, a local teacher, and Casey[2], with similar findings.

The present research was conducted in order to test the generalizability of two previous researches and to extend the categorization begun by Goodall and Casey.

THE METHOD

Children in grades 4-6 in a local school were asked to complete, in group paper and pencil format, the following computations.

1) 6 x 3 = ______________

2) 16 x 3 = ______________

3) 60 x 1 = ______________

4) 13 x 16 = ______________

5) 3 x 60 = ______________

Then the children were asked to write a story problem for 6 x 3 = ________.

THE RESULTS

The computation results were as follows:

	Grade		
Problem	4	5	6
6 x 3 =	100%	95%	100%
16 x 3 =	85%	80%	95%
60 x 1 =	95%	100%	100%
13 x 16 =	40%	25%	90%
3 x 60 =	90%	75%	100%
N	27	27	33
$\bar{x}$	82%	75%	97%

The results for the story problem were classified as follows:

1. Wrote a story involving a multiplication context.
    1.1 The multiplication context uses or implies "for each".
    There are 6 kids and they each get 3 pieces of candy. How much candy is that? 18 pieces.

    A lady went to the store and bought three six packs of orange juice. How many cans of orange juice?

    1.2 The numerousness of two classes is compared using "times" as a relational term.
    The General Store gets stock on Thursday. They have ordered 6 crates of apples. How many crates would they have if they got 3 times that many?

    I had 6 dollars. I owed my friend 3 times that much. I owed my friend?

2. The context of the story is repeated addition.
    Once there was a mommy and a daddy cat. And one day they had triplets. They were boys. And then they had triplet boys two more times. So they had 9 cats. And they they had triplets. These were girls. Wouldn't you know it they had triplet girls two more times. How many baby cats?

    Once there was a little girl and she had 6 bunnies. Her father gave her 6 more bunnies. For her birthday she got 3 more. For Easter she got 3 more. How many bunnies does the girl have now? 18

3. The story involves 6 + (6 x 3).

   Once there was a lady who had 6 cats. 3X more came along. How many cats does she have now? 18

   6 ladies had cats, each cat had 3 kitties. How many all together?

4. The story deals with multiplying as computation rather than with a multiplicative context.

   4.1 The story concerns doing a multiplication computation.

   The problem 6 x 3 = 18. It is one of the 3 times table and is one of the 6 times tables. If you switch it around it is 3 x 6 = 18 instead of 6 x 3 = 18.

   Marita asked the fifth grade math class to write a story with six times three equals eighteen in it.

   4.2 The story employs "times" as a verb rather than as a relational word comparing the numerousness of two classes.

   There were 3 barrels of beer at the party. Then a person timesed that with 6 and then how many did the people have for the party.

   If you had six apples and timesed them by three you would get 18 apples.

5. The context is wholly additive: 6 + 3 or 6 + 12.

   There were six ducks swimming in the pond. Then a while later three more ducks came so how many are there? 6 x 3 = 18. That's the answer.

   Mike had 18 dollars. He wants to buy 2 skateboards. The big one costs 12 dollars and the little one 6 dollars. So he had just enough money.

6. No context related to 6 x 3 is apparent; can't tell what the child understands.

   What is 28 - 7 = 4. What is 48 - 6 = 8. What is 10 x 10 = 100. What is 6 par plus two apples. Math is great and every one should like it to. I like it. I hope you pass. Math is great because you play games thats why I like it. Marea do good.

   My dad has 18 dogs and 18 cats and we had 6 wite dogs and 3 black dogs and 3 brown cats and 8 gray ones. One day they all ran away.

In addition to the classification of children's stories according to "multiplicativeness", the stories were categorized with respect to the structure of the story and the information it contained.

A. Didn't pose a question: made a statement or left question unasked.

Jane went to the store and bought 6 different kinds of fruit. She had 3 of each of the fruit. She didn't know how many she could eat before she got sick so she ate and ate and ate until she finally had an 18 fruit stomache ache.

Tom has 6 apples and Nickie had 3 and so 6 x 3 = 18.

B. Incomplete logical structure: left out essential information.

A lady has 6 dogs, 3 of they had babies. She thought it was fun to watch baby puppies. But how many puppies did she come up with?

I went to the store and bought 18 oranges for my Dad's lunch all week.

C. Added extraneous information or extraneous computation.

Mr. Thomas has a fruit stand. He has 6 apples, 12 oranges, 5 pears and 4 lemons. But today he is fresh out of pears and lemons. And so all he has got left is apples and oranges. How much fruit does he have left? 6 + 12 = 18.

My dad had 18 dogs and 18 cats and we had 6 wite dogs and 3 black dogs and 3 brown cats and 8 gray ones. One day they all ran away.

D. Nonsensical or impossible arithmetic operation.

If you had 6 dogs times 3 cats what would you get? You would have 18 animals.

There were 6 children times 3 more children at the big big celebration dinner for the graduate. What is the answer. 18

E. Unrealistic with respect to real life.

There was a store that had 6 oranges at $3 a piece. How much would all 6 oranges cost? = $18.00

Once a lady went out and found some dogs. She kept 6 in her room, 6 in her kitchen and 5 outside. How many dogs does she have in all?

F. Nonsensical question.

At the Little Red Store there was a lady that wanted 3 sticks of butter, 3 bananas and 3 pears and 1 pizza, 3 apples and 3 eggs. Can you think of any 6 ways to find out how many items the lady bought?

G. Child's written language makes classification impossible.

I once seen a lady who had 6 dog and they had babys they had 3# baby and the end up with 18 dog and that is the end. Thank you.

The results were as follows. (Some stories received more than one letter label. All had precisely one number label.)

CATEGORIZATION OF CHILDREN"S STORES

			A	B	C	D	E	F	G
	Grade 4	2 (.07%)					1		
1.1	Grade 5	3 (.11%)					2		
	Grade 6	16(.48%)	1		2		6		
	Grade 4	0 (.00%)							
1.2	Grade 5	1 (.04%)							
	Grade 6	5 (.15%)	1						
	Grade 4	3 (.11%)					1		
2	Grade 5	0 (.00%)							
	Grade 6	1 (.03%)							
	Grade 4	2 (.07%)							
3	Grade 5	0 (.00%)							
	Grade 6	1 (.03%)							
	Grade 4	0 (.00%)							
4.1	Grade 5	2 (.07%)	1						
	Grade 6	1 (.03%)	1						
	Grade 4	1 (.04%)							
4.2	Grade 5	3 (.11%)	1			1			
	Grade 6	2 (.06%)	1		1	1	1	1	
	Grade 4	10(.37%)	3		3		3		
5	Grade 5	12(.44%)	2		2		1		
	Grade 6	5 (.15%)					3		
	Grade 4	9 (.33%)	3	3	3		6		1
6	Grade 5	6 (.22%)	3	2	2		1		
	Grade 6	2 (.06%)		1	1		1	1	

Grade 4: N = 27
Grade 5: N = 27
Grade 6: N = 33

Summary of Results

The results of this study confirm and extend those of McIntosh and Goodall/Casey.

1. Children in grades 4-6 are reasonably proficient in multiplication computation. The more complex computation procedures (e.g. 13 x 16) are clearly more difficult than those which are less complex (i.e. 16 x 3).

2. Evidence of an ability to construct a multiplication context, even for such a simple combination as 6 x 3, was provided by few children in grades 4 and 5. Seventy-four percent of fourth graders' responses showed no multiplicative context (i.e. they fell into categories 4-6) despite children's having had two years of classroom instruction in multiplication. (Multiplication is taught throughout third grade; this study was undertaken in the last month of the school year.) The figure for grade 5 was 84 percent (!) and for grade 6 the figure was 30 percent.

3. Children's stories were categorized along two dimensions, "multiplicativeness" and story structure.

4. A large proportion of stories (i.e. 37 percent at grade 4 and 44 percent at grade 5) were clearly additive in context, even though many such stories were concluded with the statement, "6 x 3 = 18."

5. Much confusion showed up in the story problems irrespective of "multiplicativeness." Eighty-two percent of these story errors (i.e. Categories A-G) occurred in stories which were not multiplicative in context (i.e. Categories 4-6).

6. Throughout all the data -- in all grades and throughout categories 1-6 -- children's stories seemed artificial. Rarely did it seem as though a multiplicative context "belonged" to children or to their everyday actions. For example, 62 percent of all stories concerned fruits and vegetables

("Joe went to the store...") or cats and dogs ("Tom had 3 cats...").

7. Much of the difficulty children had in constructing a multiplicative context for 6 x 3 was resolved by grade 6. Seventy percent of sixth graders' stories were multiplicative (i.e. Categories 1-3) in ture. Whether the leap from grade 5 to grade 6 is the result of instruction or maturation or instruction x maturation is at present unknown.

Comments

It seems clear that children have at least three sorts of schemata concerning multiplication. First, there are computational procedures involving place value. Second, there is logical multiplication. And third, there are real world contexts aside from "multiplicativeness" involving sufficiency and ambiguity and extraneousness as well as reasonableness of information with respect to everyday life. It is clear that classroom attention to computational procedures -- the schemata of place value almost exclusively attended to in American schools -- does not resolve the schemata of logical multiplication nor does it equip children to handle the logical and real life demands posed by the present task.

Notes

1. McIntosh, Alistair, "Some Children and Some Multiplications," Mathematics Teaching, June 1979.

2. Goodall, Joyce and Casey, Shirley A., "What Are We Teaching When We Teach Multiplication?" submitted for publication.
The categories in this study were
1) used 6 x 3 and set up a multiplicative situation
2) used ÷ or + to deal appropriately with the problem
3) used 6 x 3 = 18, but failed to set up a multiplicative situation
4) used the numbers 6 and 3 but set up neither a multiplicative situation nor a multiplicative computation
5) used other numbers, etc.
6) can't tell for sure what the child understands.

Numbers in Our Life

Barbara Grigg

This activity should be completed by students working in groups of two or three. Under the appropriate number they are to list items which can be found in their life which exemplify the number indicated. For example:

1	2	3	4	5	6	7	8	9	10
unicycle	wheels on a bike	holes in a bowling ball	tires on a car	points to a star	sodas in a pack	days in a week	buns in a pkg.	players on a base-ball team	toes

Measuring - The Old-Fashioned Way

Pat Young

Jerod and Tony are in sixth grade and get very little stimulation from the math lessons. Jerod is a straight A student, who sleeps most of the day. Tony does what is asked but acts very bored. Today, I asked them to pretend there were no measuring sticks or scales -- in fact no measuring devices of any kind. Then I asked them to imagine that they were with Louis Joliet when he explored Illinois and that he had put them in charge of trading. How would they measure furs, blankets, or the many other things involved in that trading.

Jerod said he could use arm length for furs and blankets. The length of their bodies could be used. Tony thought foot length would work sometimes.

Tony said that liquids could be measured by cups or buckets. Then came the hard part -- how to measure weight as of flour, meat, or gold. They thought that would be important. Tony said it could be how much a man could hold, but Jerod said a strong man could hold more than a weak man. He did not think about equal lengths but he did weights. He decided to make a seesaw and use lead in different amounts to balance the seesaw.

Spelling Go-Round

Deanna Aebel

Children form a circle. One child starts by pronouncing and spelling a word. The next child must pronounce and spell a word that begins with the same letter that ended the previous word.

Example:	Rain - Nest - Team - Mary
Variation:	Pronounce the word only and listen for the ending sound. The next child pronounces a word that begins with the ending sound of the previous word.
Variation:	Play the game using only words from the same category.
Example:	Dog - Goat - Tiger - Rabbit (Towns is a good category)
Variation:	When a bell rings, get back to the original word as quickly as possible.

(Last two variations courtesy of Dr. Thomas C. O'Brien.)

* * * * * * * * * *

Take a Letter

Deanna Aebel

Write a vowel on the chalkboard. Ask children, one by one, to add a letter to the letter on the board to make more words. Letters can be changed around but not deleted.

Example:

a
at
bat
beat
beast

(Take a Letter is from Scott, Foresman's Spelling: Words and Skills, Book 3, Teacher's Edition.)

Commencement Address

John I. Goodlad

John I. Goodlad, Dean of the Graduate School of Education at University of California at Los Angeles, delivered the following paper as principal speaker at the Commencement exercises at Southern Illinois University at Edwardsville, June 11, 1982.

Your graduation here today and this ceremony are testimony to at least two things: your persistence, willingness and ability to learn; and the marvelous invention that historians often call "the common school." This so-called common school encompasses the elementary and secondary education you completed and, ideally, everyone else completes before going out into the work world or into colleges and universities for further education.

We have good reason to be proud of both you and our educational system. You represent that minority who not only successfully completed the common school but also went on to complete a level of education which is not at all common. You already are or will become that portion of our population which votes most frequently and wisely, which is most likely to be economically productive, and which most likely will provide the leadership in virtually every walk of life. Although some nations now equal or even surpass us in the universality of their elementary and secondary education, no nation to my knowledge has integrated into the system a more diverse array of groups. Taken together, students in the schools of California, for example, represent more than 80 mother tongues spoken in their families. In an astonishingly short period of time, the percentage of black youth graduating from high school has increased from shockingly low percentages to approximately 75 percent of the age group. This is just 10 percent short of the completion rate of white youths.

Imagine the magnitude of the task faced by the People's Republic of China in which today 90 percent of the children complete primary or elementary school but only 60 percent complete the junior high or middle school and only 30 percent the senior high school. Of this 30 percent, only four percent are successful in gaining admittance to colleges and universities.

We have good reason to be proud, then. But we also have reason today for sadness--sadness because so many of your former peers are not here today participating in this joyful occasion and basking in the congratulations of their friends and families. A few of these already have gone into jobs which pay them well, perhaps far better than will the jobs to which you aspire and into which you will fall. But many more, particularly those who did not even complete high school, will be variously disadvantaged because of the limitations in their education. Some will drift from low-paid job to low-paid job, finding themselves always outside of the kinds of life they had envisioned. Some have had little schooling and profited so little from what they had that they will function in only a limited fashion, frequently becoming wards of the state to be supported by those more fortunate. Some of us view the circumstances as being unfortunate only for the individuals involved. We fail to see, also, the degree to which all of us are shortchanged. We all suffer the consequences.

We are too inclined to believe that these differences in attainment, whether in school or in life beyond, are the result of innate differences in ability or in individual striving, or in some combination of the two. There is some truth in this, it appears, but what there is may turn out to be a temporary truth. The potential for environmental circumstances to modify inherited circumstances is not yet fully known. It is clear that individuals make varying use of common environmental circumstances and the evidence regarding the potential for increasing individual accomplishment by modifying these circumstances increases daily. Children who were virtually abandoned yesterday to a self-fulfilling prophecy are today enjoying environmental circumstances likely to assure productive lives.

Ironically, there is a group appearing to be doing just fine but which also falls short of its potential. And, again, this is because of both environmental circumstances and individual initiative in using these circumstances. This group includes you and me.

Part of these circumstances is the educational system with which we have had encounters over a good many years. The quality of this educational system depends on us and on those who run it. By "us", I mean everyone. Our educational system is only as good as what we put into it: resources, willingness to learn, teachers and administrators. The teachers and administrators often are better than the other resources warrant but if we value them little, as demonstrated by the salaries we pay them and the support and status we give them, then we will not get the best. The best will go into other walks of life.

Schools are as good as what we put into them. There is no greater challenge and no better way to serve human welfare than to make our schools the best possible. When they become as good as they should be, all of our youth will graduate from secondary schools. When they become as they should be, all of those graduating will have enjoyed equally the opportunity to learn. I am not about to read off a whole litany of what is wrong with our schools; we have had too much of that. Rather, I prefer a more positive approach. Supposing, rather, we did this rather than that? I give just a few examples.

First. imagine each child beginning on his or her birthday, preferably the fourth. We all know the importance of these early years and of sound education to them. We also know the importance of developmental progression in learning. Imagine, then, children moving naturally through activities designed to develop perceptual and cognitive abilities, preparatory to encountering letters, words and numbers instead of being plunged head-on into these within a few weeks of beginning the first grade, as is now the case. Under the present system, a child who is not six by a given date in the fall usually must wait another year—a sixth or seventh of a lifetime to date--before beginning school. I suggest beginning on one's birthday because this, in turn, suggests a birthday party. What a pleasant way to begin school!

Second, imagine each boy or girl having two sets of learning responsibilities: for one's own learning and for everyone else's learning. I am suggesting an alternative to the present conduct of schooling which is essentially one of learning alone in groups and in competition with everyone else. There sometimes is little differentiation between helping and cheating. But suppose one were expected to help. Teachers of 25 children suddenly would have 24 teaching helpers. Instead of the ratio of teachers to children being 1:25, the ratio becomes 25:1. The idea of peer group teaching is as old as civilization. We were a literate people even before we had schools, simply because brothers and sisters taught their younger siblings. Responsibility for helping one another also might go a long way toward cultivating prosocial rather than antisocial behavior. There is evidence to suggest in our society too many people who never outgrew the narcissism that is normal only for the very young. Each of us must transcend successfully our own needs and interests to identify with those of others. This is one of civilization's greatest needs.

Third, suppose we organized classes vertically instead of horizontally. Instead of the age-graded structure we have at present, which simply does not fit the realities of boys and girls but instead assumes that all fit the same bed of Procrustes, we would have a structure forcing attention to these individual differences. From the beginning, it would be the responsibility of school and classroom to fit the individual and much less the responsibility of the individual alone to fit the school. And, of course, the resulting mixed age group in each classroom would enormously aid the peer teaching approach I have just recommended.

Fourth, suppose we were able to develop educational programs so intrinsically compelling that the academic and intellectual interests of our young people stayed in some reasonable balance with other aspects of life competing for attention. My colleagues and I found recently in our research that the variety of teaching techniques employed in the classroom declines steadily after the primary grades. Routines of lecturing, questioning, quizzing, reading textbooks and doing workbook exercises dominated classrooms, sometimes virtually exclusive of everything else, beginning in the upper elementary grades and continuing through the junior and senior high school years. This was somewhat less true for the arts, physical education, and vocational education which also proved to be the most liked school subjects at all levels.

This steady decline in the use of creative pedagogy and simultaneous increase in the more monotonous approaches to teaching and learning present us with a kind of upside-down situation. At the very time that instruction is becoming less compelling, peer group values and interests are becoming more so. The answers to three of the many questions we asked junior and senior high school students are revealing. There were: (1) Who are the most popular students in the school? (2) What is the one best thing about this school? (3) What is the one worst problem in this school? In each case, students were asked to choose one of several alternative responses. From the first set of alternatives, students at both junior and senior high school levels chose overwhelmingly as their first and second choices "athletes" and "good-looking kids" as the most popular. "Smart students" ranked far down the list, chosen about equally with "gang members". To the second, by a vast majority, the "one best thing about this school" selected by students was either "my friends" or "games and sports". Ranking far down the list were what some people might consider most central to schooling, namely, "the classes I am taking" and "my teachers." Regarding this latter category, only five percent of high school students, with a paltry 3.5 percent of junior high school students, chose teachers as the one best thing. The overwhelming choices for "the one worst problem" were either "student behavior/misbehavior" or "drugs/alcohol".

What runs through these and other responses is that the adolescents attending our junior and senior high schools are heavily preoccupied with the non-academic side of their lives, while actually attending schools. Teachers, teaching, classes, the curriculum and all the rest of schooling together rank far down as bases for achieving status in school life or even as problems. It appears that schools, often accused of neglecting the basics and of failing to use those traditional methods of teaching frequently considered to be tried and tested, fail most in providing creatively designed activities likely to engage young people enthusiastically in the learning process.

Fifth, suppose we assured in the curriculum of every student both encounters with all of the major domains of knowledge and knowing as well as sustained opportunities to develop some area of special interest and talent. All of you graduating here today have completed three levels of schooling. And yet, many of you have had no sustained exposure to the arts. Many who may have met at least minimum requirements for foreign languages merely took courses and passed exams. You would be virtually no better off in conversing with a speaker in that foreign language than if you had not encountered the language at all. Many of you know virtually nothing about the great religions of the world. And yet, the civilization of which you are a part cannot be understood or fully appreciated without some acquaintance with the role of religion throughout the whole of history and in all aspects of life. Some of this deficiency is your fault. You have chosen badly among the curricular alternatives presented to you. But since education is a lifelong opportunity, I trust that you will proceed to make up these deficiencies.

But these deficiencies are perhaps even more the fault of the educational system and those who create its policies. We have argued for what has become the sloppiest of elective systems, largely on the grounds of meeting individual differences among students. Instead, we have given up on many students, assuming that they could not or need not have a broad and comprehensive education but are better off learning only what they elect to learn. Some people would argue that our young should study only that in which they are interested. There is some merit in encouraging students to follow their interests after they become involved in a domain of knowledge but how in the world are they to become interested in something with which they have had no experience whatsoever? As a result of questionable theories but even more as a consequence of our casual approach to curriculum planning, the curricula of our secondary schools and colleges are for the most part quite chaotic and indefensible.

In some of the senior high schools in our sample, over 40 percent of the teaching force was allocated to vocational education. Sometimes, this percentage equaled the total of English, mathematics, science, social studies, and foreign language teachers. Does this make sense? Individual high schools varied widely in the teaching resources devoted to various subject fields. How does one explain and justify only three percent of the teachers allocated to the arts at Fairfield High but 12 percent at Palisades. Or, at the junior high level, how does one justify four percent of the teachers in vocational education at one school and 22 percent at another? Or, why seven percent of the teachers at one school teaching science but 20 percent teaching science at another. One could go on and on with such puzzling and disturbing data.

Then, when one looks inside these domains of knowledge, one finds extraordinary differences not only between and among schools but also within schools regarding the courses taken within a given field. Within a single high school, subject matter being taken by students in the low tracks is likely to differ widely from that being taken by students in the high tracks. Is this what we want? Is this what we should have?

This curricular anarchy will not be rectified simply by adding more courses in a given field or by specifying the teaching of this or that course, although such is being widely recommended. No, we must ask ourselves more fundamental questions.

We must determine what is worth knowing and what is feasible for knowing in a common school. This means sustained exposure of all to mathematics and science, literature and language, society and social studies, the arts and the vocations. Each must have a protected place in the curriculum; the place of each must be protected by minima and maxima so that students who do poorly in mathematics are neither encouraged nor permitted to take remedial work to the exclusion of the arts. And so that students gifted in mathematics do not engage in mathematical studies to the exclusion of literature and language. The limitations and excesses in the curricula of individual students are direct consequences of both neglect and the parochial interests of those who have both the authority and responsibility for deliberate planning.

But, suppose that in addition to encounters with these five domains each student had a continuing opportunity also--an equally protected opportunity--to spend, let us say, up to 10 percent of his or her time in pursuing the development of some individual talent, or even several talents, each engaged in sequentially and intensively over a period of years. I would include in this category the arts, creative writing (in case this area might be omitted in some conventional definition of the arts), an academic domain such as mathematics and athletics. I shall not enter here into the benefits coming to individuals as a result of mastering difficult techniques or concepts to a level of high competence, nor shall I argue the benefits of habits learned in talent development transferring to other areas of learning. Substantial arguments for both sets of benefits can be mounted.

It is clear that secondary schools are not equipped and staffed for talent development. Further, school domination in this domain runs the danger of corrupting the process with prerequisites, marks, promotion, and all the other irrelevant trappings of schooling. Rather, the development of talent means learning something to the point of excellence for its own sake.

Since schools are not equipped and probably should not be equipped to provide the instruction required, I recommend that each student be given vouchers worth approximately 10 percent of the cost of his or her education with which to purchase instruction in the open market. One would go to talented musicians and painters for instruction and would not be constrained to use only teachers certified for the schools. One could attend the classes of outstanding swimmers and divers and secure even individual instruction. One might secure as tutors mathematicians, scientists and engineers.

Schools do not need to be as they have been. But they remain, year after year, very much as they were decades ago. Teachers do not need to teach as they do, nor need they be trained as they are. But the teaching practices teachers use today are very much like those teachers used decades ago and the teacher education they received is so limited and inadequate that teachers simply do not transcend the conventional wisdom of their own profession. They teach as they were taught over the years when they themselves were students at the elementary, secondary and tertiary levels of schooling. We will not change what exists very much--although we can do a great deal of modifying of what exists--until we prepare and accommodate in our schools at least the nucleus of individuals trained at the highest level of understanding their subject fields, human development, and processes of learning. To attract such individuals into teaching and not into other professions means that we must pay them salaries commensurate with their preparation and provide at least a few teaching positions in every school where they will have an opportunity to serve as head teachers. This last is an idea that has been offered many times but which has almost always been found by the teaching profession itself to be unacceptable. But, until something of this kind occurs, teaching will remain the poorly paid vocation it always has been and there will be little or no opportunity for upward mobility without leaving teaching and entering administration.

Some of you in this audience already are or are about to become teachers. I hope that at least a few of you will become leaders in creating the kinds of schools we could and should have. Most of you will not become teachers. But you are citizens of this country or some other and most of you will become parents. Consequently, each of you has both a general and a specific stake in the quality of schools. You must assure the support schools need if they are to become the schools we should have. Above all, this means attracting into schools and into the entire education profession a proportion of those most able people who otherwise would be doctors, lawyers, communication specialists, and leaders in business and industry. To have good schools is to have citizens capable of maintaining a democratic society.

Baby's

Lisa Leardi

All baby's do is laugh or cry,
   some of them wave good buy or some of them say hi.
But what I like best about baby's is there sung and warm,
   and there so tiny when there born.
And also they whey six, seven, eight pounds,
   not like dogs or not like hounds.
Baby's are so cute all day long,
   even though they can't play ping pong.
Baby's like to sleep and sleep,
   do they even make a peep?
I have a baby brother of my own,
   he sure cry's and boy does he moan.
They drink there bottle till it's gone,
   and when they get up then it's dawn.
They make even the funnist sounds,
   almost like hounds.
So when you see a baby don't stare
   because you reely know it is there.

This poem was written by Lisa when she was a second grade student at St. Mary's School in Edwardsville.

Thinking Isn't Always Linear

Gary L. Walker

Problem: The 7 and 8 keys on my calculator don't work. How might I find the sum of 274 + 882 + 1,028?

Following are two responses concerning how this problem was figured out:

Mark: First you have to find how to put 274 into the calculator without using the 7 key. Do this by putting 264 in it. I figured this out by using the same number in the hundreds place and in the ones place. I used 6 in the tens place because it was the closest number to 7 that was usable. I didn't use 8 because you said the 8 key doesn't work. Now you add 10 to 264 and you get 274 in the calculator.

Now I have to figure out how to put 882 in the calculator without using the 8 key. First, I put 992 in the calculator because it was the closest number to 882 that is usable because the 7 key does not work and therefore you could not use 772. This is beginning to sound like a theme or something. Next I subtracted 11 from this number to get 882. But instead of getting 882, I got 881. So I just added 1 to 881 to get 882. Now I see the mistake I made. I put 992 in the calculator and subtracted 10. That came out to 982. So to fix this, I have to subtract 100 to get 882 in the calculator.

Next I have to figure out how to put 1028 in the calculator without using the 8 key. First I thought that I could put 1020 in the calculator and then add 8, but this did not work because the 8 key does not work. So I then put 1030 into the calculator and subtracted 2 to get 1028.

Then I added all my statements up and got 2184 for the answer.

Danny: First you have to find a way to get that amount on the calculator without using the 7 and 8 keys. So the first one you take 274 subtract 10 in your head, you get 264. Then you take the next number, subtract 100 from 882, you get--wait, you can't use that. Change it to 220 to get 662. I subtracted 220 from 882. Then take the next number which is one thousand twenty-eight. Subtract two and get one thousand twenty-six. Then you add 1026 plus 2 plus 662 plus 220 plus 264 plus 10 equals whatever it equals. I punch it in the calculator and it equals 2184.

To change the 274 so that I could make it go into the calculator without pushing the seven or eight, I thought you could subtract ten and then add it back later. I thought of ten because the number I need to change it is in tens place.

The next number 882 I had to change the tens place and the hundred's place--so, I tried taking 110 from 882 which did not work because that left me with 772. So then I tried to subtract 220 from 882. Then I got 662 which will work.

The next number I had to change the one's place because you can't use the eight. So then I tried one which ended up 1027 which didn't work, and I tried to subtract two from 1028 which did work and I got 1026. So, I added all of those together and you get your sum without using the 7 or the 8 keys.

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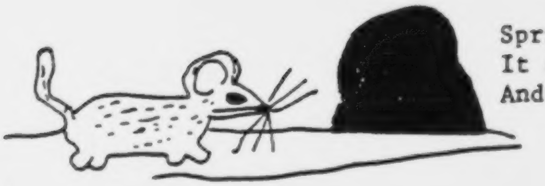
Spring



Spring is like a mouse
It crawls around in silence
And then vanishes.

--Brian Luebbers

What Can You Make of It?

Barbara Grigg

This is an activity which challenges students to do some innovative and creative thinking as they try to think of something they could make by combining the pair of objects listed below. For example, if pliers and shoestring were listed as a pair, one possibility which could be made could be a pendulum.

Allow the students to work in groups of 2 and 3.

1.	Sheet of paper	glue	________________
2.	nail	cane	________________
3.	skis	coat	________________
4.	screwdriver	rag	________________
5.	clamshells	shoelace	________________
6.	cellophane	candle	________________
7.	wire screen	barrel hoop	________________
8.	hairpin	button	________________
9.	broom handle	newspaper	________________
10.	golf club	necktie	________________
11.	rubber band	oak leaf	________________
12.	safety pin	string	________________
13.	manhole cover	chain	________________
14.	inner tube	barrel	________________
15.	wire	powderpuff	________________
16.	key chain	stick	________________
17.	needle	clothespin	________________
18.	cork	spring	________________
19.	coat hanger	rock	________________
20.	cotton	pencil	________________

Mock Checking Accounts

Linda Cadell

This activity is an attempt to teach students at the sixth grade level the real-life skill of how to write checks and balance their checkbooks. There is a lot of practice in addition and subtraction. If you have access to enough calculators, you can use this activity to introduce the proper use of calculators to your students.

I have made up a ditto of "dummy" checks. The first step is for each student to make a checkbook. They are each given 10 "dummy" checks. We then discuss each part of the check, what it is used for, and how each section is filled in. Then the students put their checks in a wallpaper checkbook, number their checks, and personalize them. The second step is to introduce a check register. This is a sample of what a typical check register would look like.

CHECK REGISTER

NUMBER	DATE	DESCRIPTION OF TRANSACTION	PAYMENT DEBIT	FEE	DEPOSIT CREDIT	BALANCE

With the register and their checkbook in front of them we discuss each column of the register and where you can find this information on the check. We also discuss at this point how you figure a new balance.

Then you are ready for the students to try to write some checks and balance their checkbook after writing them.

These are the instructions I give the students.

1. You will start with $250.00 in your account.

2. All checks have a $.25 fee.
3. Everytime you make a transaction make sure you figure a new balance.
4. Make the following transactions:*
    a. record your $250.00 balance in the register.
    b. write a check for $50.98.
    c. write a check for $100.00.
    d. write a check for $75.66.
    e. make a deposit of $75.00.
    f. write a check for $20.25.
    g. write a check for $15.10.
    h. write a check for $25.00.
    i. write a check for $28.76.
    j. make a deposit for $178.00.
    k. write a check for $75.66.
    l. write a check for $52.61.
    m. write a check for $38.27.
    n. What is the ending balance?

*Everytime you write a check make up a logical expense that check could be covering.

I have the students make up their own reason for a check because it makes them really think about the money and not just about the mechanics of writing the check and doing the addition and subtraction. They also seem to enjoy coming up with their own companies and purchases to fit the different check amounts. After they have completed this exercise and we have checked to see that everyone has the correct balance in their account, each student then makes up his or her own set of transactions. They figure a balance for their set of transactions. They they trade lists and someone else makes a checkbook, writes the checks, fills in the register, and computes a balance. They then compare figures to see if they have the same balance. If not, they together go over their figures to find the correct balance.

I think this is a valuable exercise in showing students a practical way in which math knowledge will affect their lives. It is important that as adults they have these skills. Even if they have access to a calculator to do the math, if they do not understand what the parts of the check are, how to fill in the register, and how to compute the balance (when do you add and when subtract) the calculator is of no value.

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Dandelion Math

Pat Young

All children love to pick and blow dandelion seeds to everyone's dismay. Have the children pick dandelions that have grown tall in the weeds. Ask them to estimate the number of seeds. Then ask them to count the seeds. Some children will remove all the seeds and then count them. Others will count as they remove the seeds.

Children can multiply to save time in counting. If they count half they can multiply by 2, or count a fourth and multiply by 4. This is an interesting way to introduce fractions. After blowing the seeds ask the children what portion remains, or what portion is gone.

Note: Do all dandelions produce the same number of seeds per flower? Some interesting data collecting can be done now. Average? Maximum? Minimum? How about other flowers?

Find a Pattern

Charles May

Challenge students to find a pattern in the following puzzle:

1. Choose a three-digit number.
2. Reverse the digits.
3. Subtract the smaller from the greater.
4. Reverse the digits again and add.

Note: A variation on this problem.

1. Same
2. Same
3. Same
4. Reverse the digits again and subtract.
5. Continue as far as you can.
6. Choose other numbers and repeat.
7. Look for patterns.

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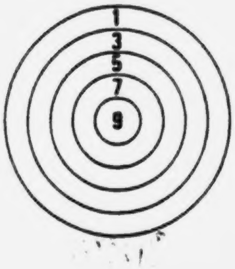
Darts

Gary L. Walker

Problem: Luisa was playing darts. She threw 6 darts, and all 6 hit the target shown. Which of the following could be her score?

4, 17, 56, 28, 29, 31



Tell a Story

Diane Husmann

Materials:

Fact cards with sentences of the form 7 - 2 = _______ for each number fact presented so far.

Box

Steps:

1. Mix the cards up thoroughly and place them in the box.
2. Separate the class into two or more teams. The teams take turns drawing cards from the box.
3. When you draw a fact card from the box you must tell a story about it and give the correct answer.
4. When team members give the correct answers, they keep the card. When they are unable to tell a story or give the correct answer, they put the card back in the box.
5. The game continues until all cards are drawn from the box. The team with the most cards is the winner.

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A Thinking Activity

Gay Rasler

Divide your class into groups of three or four. Instruct your students to:

1. List all the foods you can think of that are blue.
2. List all the things you can think of that have four wheels.
3. List all the things you can think of that need keys.

March Is the Year of Summer

Deanna Aebel

A child will learn when he or she is ready and not necessarily when the information is dispensed by the teacher. A child is not an empty vessel waiting to be filled by some outside source. Here is an example:

> In March (first grade) we had a lesson concerning the month of March, special days in March, and the fact that spring begins in March. The children then wrote sentences concerning the month of March. Here they are:

I like March. March is time for St. Patrick's Day. March is time for birds to fly. ---Rachel

March is when spring starts. I like it. ---Katie

March is nice. Do you like March? In March there is St. Patrick. ---Chad

In March the birds come back for the summer. Then the birds will go back for winter. Then the birds will come back for summer. ---Zachary

March is before spring. March is a month. March is my favorite month. ---Carrie

March is nice. Do you like March? Yes I like March. ---Chris

March is when the Easter bunny sometimes comes out in March. March is when summertime comes. ---Jinger

St. Patrick's Day is in March. Do you like March? March is green. ---Derek

March is pretty. March is Easter. March is nice. March is St. Patrick's Day. ---Gretchen

March is my favorite year. Birds come back. St. Patrick's day is in March. ---Michael

March is in St. Patrick's Day. March is nice. March is a nice year. ---Karri

March is fun. March is the year of summer. March is nice. ---Joshua

March is in Easter. March is nice. March is in St. Patrick's Day. ---Josh

In March summer starts. Sometimes Easter is in March. St. Patrick's Day is in March. ---Jerilyn

In March Matthews has a birth day. In spring is a good day. Don't you like March? ---Laura

I like March. Do you like March? March is summer. ---Jeff

March is fun. March is the time for St. Patrick's Day. March is the day for spring. ---Shawn

On March is the day of spring. There are different flowers in spring. ---Aaron

March is the day of spring. March is a good day. It is a pretty day. ---Andy

March is a good year. St. Patrick's day is in March. I love March. ---Chris

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T.V. Analogies

Barbara Grigg

1. Motorcycle is to Fonzie as ______________ is to Batman.
2. Hawaii 5-0 is to Honolulu as Good Times is to ______________________.
3. Archie Bunker's Place is to Dallas as Happy Days is to ______________.
4. Fred is to Pebbles as ________________ is to Jan.
5. Policeman are to Hill Street Blues as doctors are to ________________.
6. Dennis Weaver is to Chester as ______________ is to Rowdy Yates.
7. Bullwinkle is to Bugs Bunny as The Price is Right is to _____________.
8. Dan Rather is to CBS News as _______________ is to NBC News.
9. Magpies are to ________________ as puppets are to The Muppet Show.
10. Snoopy is to Peanuts as _______________ is to The Tom and Jerry Show.
11. Wojo is to ________________ as Furillo is to Hill Street Blues.
12. Daisy is to the Dukes as _______________ is to WKRP.
13. The Dukes of Hazzard is to Dallas as Boss Hogg is to ________________.

Observations of Children's Thinking

Kathy Kittock

Due to my not having a regular classroom, I observed at our local public school, during the morning when the teacher said that the children would be more alert. I worked with several groups of four children on several different activities. I would like to make some overall observations before I get into specifics. The children that I worked with were 6 years old -- this being the end of the year, they have completed a year of kindergarten. They are extremely enthusiastic. When asked, "Who wants to come work with Ms. Kittock?" almosteveryone's hand went up. The assistant teacher told me that they couldn't give them enough work to do to keep them happy -- actually she said, "When we try to tell them they'll have extra work to do because they're being bad, they consider it a reward." . . . . . and then

the thought comes to me

Why can't children go on having this enthusiastic attitude towards learning? And, should a teacher give extra work such as workbook pages, if a child misbehaves? Are we in fact, saying, "Hey! This is supposed to be drudgery!"

and then

the thought comes to me

Are teachers forgetting that children are people? And, that part of being "people," is really caring and sharing but most particularly listening. . .and just taking time. . .to be in touch and together. If we expect our children to be reflective, don't we, too, need to set the mood or the tone, by also being reflective?

and then while we work in our little group. . .

a teacher in the hall is scolding someone -- someone in the first grade and the kindergarteners listen. Her scolding is loud (much like a person reading a book and dramatizing what an angry person might sound like), and the children listen. One little boy says, "That's Mrs. _______! Boy, I'm glad that I can't come to this school next year!" And, the little girl standing by him, working away on sorting buttons, says, "I can't come here either!" and the next little boy says, "I can't come here either"! and I'm thinking "Someone's got to be coming here next year."

and then

the thought comes to me

This is how fear of school sets in.

and another thought, however this is a memory of my own son, Anthony. When he was in second grade there was and still is a teacher who is very very TALL! (And, of course, they are very, very short.) Every few days Anthony would develop a terrible stomach problem but he never ran a fever. This went on until I was positive that he wasn't ill at all, and I talked to the principal about it. But in the meanwhile, I had talked to other mothers and they were all having the same problem with their children. They were all so scared of the teacher that they were getting sick! I let the principal know -- as tactfully as possible -- and things worked out . . . . is this typical for 2nd grade? And must the children pass through this trauma?

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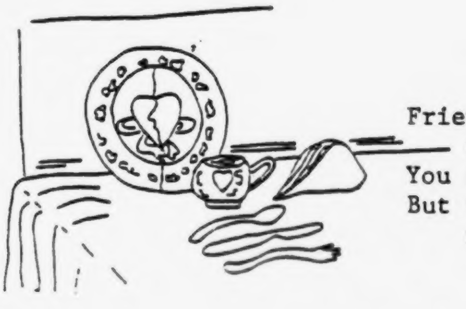


Don't Drop the China

Friendship is like a piece of china
so easily broken.
You can put the piece back together,
But there will still be a crack. . .
never forgotten.

-- Jenny Nehrt

What a Discovery!

Barbara Grigg

In a letter to my fifth graders at the end of this school year, I wrote these words:

> "This year has been a special year for me. I've been challenged by the curious minds of some and by the eagerness of others to learn. You, the graduating class of 1989, are a very unique group of kids. You have the talent and determination to go far in life; and I hope you use it. . . ."

As I reflect back to the beginning of the school year, I wonder if I'm talking about the same group of kids who entered my room August 21, 1981. Surely not! Could I have been talking about the same group of 30 kids who had the reputation of driving teachers into considering early retirement? Could I have been talking about the same group of kids who had me, a veteran teacher of 10 years, worried and afraid that I wouldn't be able to handle these unmanageable, loud mouthed, sarcastic kids? Yes, it's the same group!

Since I'm no miracle worker and don't pretend to have all the answers to correct discipline problems, I'm writing this to share what I feel was the key to changing these dreaded, disruptive kids into ones who were filled with ideas, smiles, and enthusiasm. This key is what is called activity learning.

Activity learning is child involvement. It's that type of learning in which the child actually becomes physically involved with learning. He's creating, manipulating, and actually becoming a part of the learning situation.

After being introduced to activity learning last September by Dr. O'Brien, I began in my own classroom to try simple classifying activities. I started by collecting a pencil from each student and letting students work in small groups to classify them into categories. When we began comparing these categories, to everyone's amazement there were 14 different categories. Learning was budding!

In a day or two, Ten's Patience, a math ordering game was tried by my students. They became so excited and involved that they actually created 7 different "bends" to the game. It was at this point that I knew I had found the answer to the problem. These kids needed activities which challenged them, excited them, and most of all, involved them.

I now saw my role as teacher change from being a disciplinarian of disruptive kids to a challenger of inquisitive minds. I knew that these bright energy-activated kids needed a place to focus all their creative energy. They were powerplants generating ideas; and, they needed somewhere to express them.

Throughout this year, I've tried to fulfill this role as teacher by interacting with these kids, listening to them, and providing activities where they could think, discover, and wonder. This year these kids created a 10 page newspaper entitled, "The Eagle Express"; they directed and starred in a video recording of a TV play called "Rumpelstilskin; and, they became obsessed with Greek mythology. They found learning could be fun and wanted a part in it. They really wanted to learn.

Of course, everything this year wasn't always rosy. There were trying days for both the kids and me! But, all in all, it was a great year. It was an active year where these kids learned they could like themselves: they could challenge themselves; and most of all, they could think for themselves!

What a discovery!

Teaching Mathematics in Mixed Ability Groups

David Lingard

In August 1980 Shirley Casey and I took part in the Fourth International Congress on Mathematical Education, University of California, Berkeley. One of the high spots of the Congress for me was the paper presented by David Lingard, Northcliffe Comprehensive School, Doncaster, Yorkshire. Here, with David Lingard's kind permission, is the paper in full. --TO'B

The original suggestion for the title of this panel was: "Mixed Ability Classes in Mathematics: Problems and how to cope with them." "What are the most crucial problems associated with mixed ability classes in mathematics?", the panel description asked.

I was not happy with this title. It seemed to present mixed ability teaching in a rather negative manner. I felt that I wanted to be more positive and cheerful.

However, it is with the problems that I wish to begin.

I have been teaching mathematics to mixed ability groups of 11-16 year olds now for eleven years, in three comprehensive schools, and over this period I have gradually been drawn to the following conclusion:

There are no problems in teaching mixed ability groups but there are a lot of problems in teaching mathematics. To put it another way, problems associated with teaching mixed ability groups are solely problems of teaching mathematics.

What has happened is that teaching the full range of ability within one class has made some of the problems of teaching mathematics more apparent. Certain difficulties have been highlighted and consequently teachers working in this way have focussed their attention on them.

For some teachers it has made them aware of problems whose existence they were previously unaware of.

I would suggest three particular reasons as to how this has come about. Teaching mixed ability classes,

i. teachers have been required to pay close attention to individual children,

ii. teachers have found it necessary to re-examine their aims and objectives in teaching mathematics,

and iii. teaching all abilities has encouraged teachers to offer a wider mathematics experience to all children.

The growth and development of mixed ability teaching over the last 15 years has served a most useful function. It has acted as a means of diagnosis for many of the problems relating to the teaching of mathematics. Of course, it has not necessarily always provided a therapy!

Some teachers, faced with the problems that they felt were presented by mixed ability teaching have retreated to previous practice hoping, or falsely assuming, that the problems would no longer be with them.

Mixed ability teaching has brought its own advantages in addition to this valuable diagnosis. The advantages are numerous and have been well documented by me and many others, including, for example, in the Schools Council report published in 1977.[1]

For the moment, perhaps I could just reiterate what, for me, are two of the major advantages:

1. Raising student motivation, mainly through countering teacher expectation of pupil performance. An end to the premature and mistaken 'labelling' of children.

2. Raising academic standards for all, but in particular for the most able. Previously these students were so often unwittingly held back by teachers imposing a ceiling on their performance--related to what the teacher thought a child should be able to do in the fourth year or the top set or the exam group.

But perhaps in the long term, as far as mathematical education is concerned, the greatest single asset and advantage to stem from mixed ability teaching will be the focus that it has brought to some of the very many complex problems of teaching mathematics.

I would like to expand upon the general point that I have made and try to illustrate it from my own experience and that of many colleagues.

The problems of teaching mathematics to mixed ability classes are not problems about suitable classrooms, adequate resources, reprographic facilities, computerised learning programmes, lack of suitable text-books, methods of assessment, etc., etc.

They are related to 3 things:

1. The teacher's view of what mathematics is.

2. As a consequence of (1), the teacher's view about the ways mathematics can be taught and learned.

   and

3. The teacher's attitude towards children and their respect for children's mathematics.

Those who have taken up mixed ability teaching at secondary level have been forced (consciously or otherwise) to face these 3 issues. Those who have survived the challenge (and in the preceding talk Denis Kennedy has clearly illustrated some of the problems for teachers in doing so) have come to know that teaching mixed ability classes is not the issue. The issue is teaching mathematics.

Let me take these 3 points in turn and look at their implications for the teaching.

1. What is mathematics?

    It is more than a body of knowledge, a bundle of facts and techniques.

    A lot has rightly been said and written in recent years about mathematising and about humanising mathematics.[2]

    Mathematics is an activity. It deals with skills and processes and ideas, It is something experienced and developed by each individual.

    The implications for school mathematics teaching here are considerable:

    Certain topics and pieces of mathematics are not sacrosanct.

    Content is not the primary concern but is subjugated to the context (context of application, of the learner, of the teacher, of the time).

    There is not a clearly defined linear progression of what mathematics should be taught and in what order. Achieving a coherent mathematical education for each child is important, but this is not the same thing.

2. Ways mathematics can be taught and learned.

    It follows that you cannot simply hand over your mathematics (or anyone else's) to children.

    The teacher is there to promote and facilitate learning. To provide starting points for an experience. To guide and respond.

    I first appreciated the futility and irrelevance of much of our traditional classroom teaching when I read Caleb Gattegno's hilarious parody of the passing on of knowledge to children, via lessons, tests, homework, examinations, etc., in his book What We Owe Children.[3]

    A. N. Whitehead[4] also had similar things to say about this, particularly about 'inert knowledge'. (I'm not sure whether to feel encouraged or worried to discover that President Carter reads the same books as me!)

    Denis Kennedy has already emphasised the need for a variety of modes of learning and teaching. I support his view so strongly that I would like to repeat what he said:

"The teaching methods should change; one day a student might be working alone, later he is paired off with another, a week later he might be grouped with 5 other students and at some time he might find himself in a class lesson."

(I think that I would have said that he should find himself in a class lesson.)

All my experience tells me how important this statement is, and it is a view strongly supported by the Schools Council working party.

How have we got away with the monotony of class lessons for so long?

In particular I feel that I must oppose fiercely the use of individualised learning programmes where they are used to the exclusion of all else--as in England they so often seem to be--and where students are left to plough their own lonely furrow for lesson upon lesson, working at 'their own pace'--accurately observed by some to mean 'snail's pace' all too often.

3. Respect for children and their work.

There has to be respect for children as doers and creators of their own mathematics. Their feelings have to be respected and their point of view listened to, developed and encouraged.

Discussion of their mathematics, writing about their mathematics are crucial and essential steps in their mathematical development. Teachers of mixed ability classes have been quick to recognise this.

There is little new here. A number of teachers have accepted all that I have said. English primary schools contain many such teachers. At secondary level, however, this has rarely been the case, and still is not.

So far I have talked in rather general terms and may not have been as specific as some of you would have liked. I will try to remedy this.

Successful teachers of mixed ability groups have been forced to use not only a variety of styles and modes of teaching but also a variety of materials and texts. They have been eclectic in their choice of text-books or work cards. No one text-book or scheme is good enough for a single child. How foolish that we ever believe it to be so!

In the early 1960's many felt that the introduction of the 'new maths' would solve some of our problems and enable us to produce a numerate population. I remember writing in 1970 that my fear was that when the dust settled after this 'revolution', little would have changed and we should be no further forward along the difficult path of maths education.

Ten years later I think that current practice, at least in the U.K., supports my view. The issue is not about content and teachers of mixed ability groups are aware of this.

Peter Coaker, who is at Berkeley, a member of British Petroleum and an enthusiastic and noted supporter and worker for maths education in England, recently suggested at a meeting of the Schools Council Mathematics Committee that it would be a good idea if, when the time came to finally assess pupils' competence at mathematics before they left school, we sat four children around a table, presented them with a problem and then asked them to talk about it. He went on to suggest that such an assessment might constitute half of their final assessment.

Teachers of mixed ability groups would leap at this splendid proposal! My guess is that many others would be terrified by the prospect.

I have already mentioned the need to focus on individuals. One particular development has been the attention paid by teachers to the mistakes made by children and the analysis of these mistakes.

Examples of this from my own classroom and others are well illustrated in two articles published recently by David Kent, a former colleague and a friend of mine, published through the National Foundation for Educational Research, entitled "Some ways in which mathematics is lost".[5] This research was undertaken by David as just a part of his normal classroom activity as a teacher in our mixed ability classrooms at Belper and elsewhere.

I was, for example, able to appreciate why Susan thought that $2x - 5 = 39$ was a stupid statement, because the classroom situation allowed us to sit and talk about it. (It wasn't because Susan couldn't accept x as a number. It wasn't because she didn't like equations. It was in fact because she couldn't see how you could take 5 away from twenty something and be left with thirty-nine.)

Teachers teaching mixed ability classes have again been forced to work together more closely (as Denis Kennedy has illustrated), enabling strengths to be utilised, weaknesses supported, interest developed. Chuck Allen in his talk has indicated just how wide and diverse this spectrum of interests, talents and experience is.

This has led to a much needed greater degree of professional honesty between teachers. Many of the mathematics department at my own school seem to find it difficult to cope with my regular discussions about the problems that I am having in teaching mathematics (they have not been used to teaching mixed ability groups and working together in this way). He is the Head, I can see them thinking, and he has all these problems and he talks about them!

But in addition to co-operation there has to be autonomy for the teacher. Individualised learning programmes threaten and sometimes remove this all together.

Autonomy of the teacher in one sense has been a noted feature of the English educational system, although at present it is seriously threatened by frightened politicians and powerful employers and others who do not understand the complexity of the problems faced by teachers.

Autonomy *in another sense* will always be there. As I indicated earlier, the teacher's attitude, relationship with children, view of mathematics, emphasis on particular topics, etc., are all of paramount importance and no prescription or statute from above will ever change this fact.

There must also be student autonomy. What work to do, when to do it, how long to spend on it, who to consult with, what books to refer to, how to record the work . . . , these are all legitimate claims for students to make and teachers to accept.

Mixed ability classes have frequently accepted this need and faced the consequent organisational re-adjustment. But the re-adjustment is not the problem. The problem was accepting the need for it.

I think many of us have been (and still are) constantly amazed by the ability, persistence, resilience of children to accept responsibility for their own learning, to work on their own for periods of time, to sustain a piece of work for weeks, to accept the *responsibility* that goes with the freedoms offered.

Teachers of mixed ability groups have regularly reaped this reward.

The need for *variety* also applies to assessment. The foolishness of trying to assess mathematical competence by a single means of examination now seems transparently obvious.

In mixed ability teaching it just isn't *possible* to get away with this. It isn't desirable in *any* sort of teaching.

Finally, one hobby horse.

During the last ten years I have found one vehicle to help meet the challenge posed by some of the problems mentioned. I am speaking of the use of mathematical investigations in the teaching of mathematics.[6]

I have had children of all ages spending as much as seventy per cent of their time on investigative work. The advantages have been considerable:

(i) they have encouraged children to spend more time on the processes and strategies in mathematics.

(ii) they have given the children an opportunity to create and develop their own mathematics.

(iii) they have enabled children (*including* the least able) to get a feel for *pure* mathematics, and to know what it is to work as mathematicians.

(iv) they have encouraged children to discuss their mathematics and to write about it.

Ten years ago there seemed to be only a handful of teachers working in this way with children. The growth of mixed ability teaching has helped to promote more use of investigative work and I was delighted that this Congress was able to make space for a panel on this topic.

The conference programme refers to 'disadvantages'. What can I say? It is very hard work but you seem to learn a lot. I feel certain that the development of mathematical education has been enhanced by the contribution made by mixed ability teaching.

KEEP MOVING

Drivers of cars are always being urged to keep a 'safe distance behind the car in front.' But what is safe?

Drivers in Holland are advised, by the Durch Highway Code to ' .... keep at a distance in metres which is half the speed (in km/hour) at which you are driving.'

So a Dutch driver driving at 60 km/hour, should keep 30 m behind the car in front of him.

Suppose that, on a new busy city ring road in Holland, the intention is that as many cars as possible should be able to use the road simultaneously. That is, that each minute as many cars as possible should be able to pass any particular point. Taking account of the Dutch Highway Code advice and assuming the average length of a car is 4 m, how fast should cars travel?

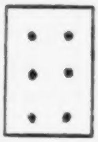
* * * * * * *

BRAILLE

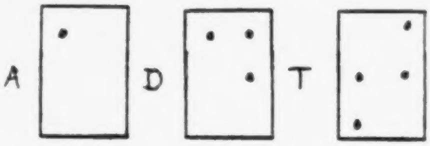
Louis Braille, a Frenchman living in the 19th Century, invented an alphabet for use by blind people.

The alphabet consisted of raised dots in rectangular patterns.

Each pattern of dots was based upon a 2 x 3 rectangle:

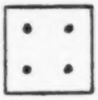


Some patterns used are given below:



How many different patterns can be made using this system?

Suppose Braille had used this as his basic pattern. How many possible patterns now?



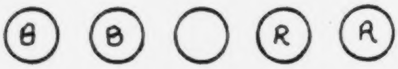
What about a 2 x 4 rectangle? Any rules?

* * * * * * *

The children's work in this pamphlet was produced by students at Belper High School, Derbyshire and Northcliffe Comprehensive School, Conisbrough.

FROGS

Place two red pegs and two blue pegs in a line on a pegborad with a hole in between them:



Try and interchange the blue and red pegs but moving them only according to these rules:

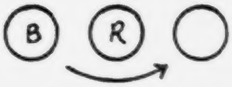
(1) Blue pegs move only to the right, red pegs only to the left.

(2) A peg may move either

(i) into an adjacent hole

or (ii) by jumping over a single adjacent peg of the opposite colour into a hole.

e.g.



Can you interchange the pegs using these rules?
If so, how many moves does it take?

Try the problem again with 3 pegs of each colour.

How many moves are needed for n pegs of each colour?
Can you prove your result?

Suppose there are m red pegs and n blue pegs.

* * * * *

CHAINS

17 → 52 → 26 → 13 → 40 → ?

What is the next number in the chain?

What are the rules?

Continue this chain, and then, make some more of your own, starting with different numbers.

What happens? Does every chain end the same way?

What is the longest chain you have got?

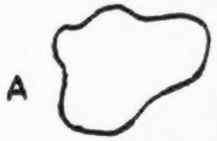
Invent some new rules and investigate your new chains.

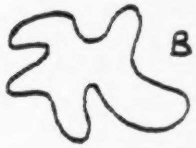
* * * * *

COMPACTNESS

What does this mean? Can you explain what we mean by compactness without drawing a diagram to help you?

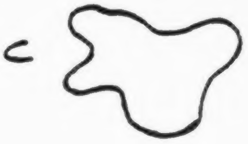
Which is more compact, A or B?

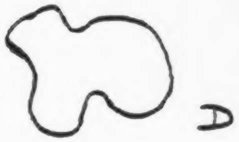




Most people would agree that A is more compact than B.

But what about these two shapes:





Not so easy!

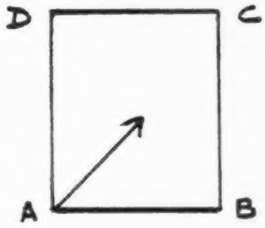
How can you measure compactness?

Invent some ways of measuring it, and then test them out.

* * * * *

BILLIARDS

I have a rectangular billiard table with pockets at the four corners A, B, C and D. I start with a ball at A, and hit it along a path at 45° to the cushion, thus:



Assuming that

(i) the ball rebounds from the cushions at 45°

(ii) it keeps rolling until it drops into one of the pockets

(iii) the length and width of the table are both integral and known.

Is it possible to predict

(a) which pocket the ball will end up in

and (b) how many times the ball will have hit a cushion?

Investigate the situation if the ball is initially hit from E (still at 45° to the cushion), where AE = 1 unit and E lies on the cushion.

* * * * *

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* * * * *

Kindergarten Graphs

Charlene Modla

My kindergarten students come to school all day. Therefore we have lunch money and milk money to take care of every morning. It's always been a chore for me to find something constructive for the children to do while I wrestle with the lunch and milk money.

We decided to make a graph of how many students were eating hot lunch and how many brought their lunch.

I took a large piece of construction paper and made two columns of squares, then I put it on the wall where the students could see and reach it easily.

As the students, one at a time, brought their lunch or milk money up to my desk I would then ask them to go color in a square, blue if they brought their lunch, red if they were eating hot lunch.

When we were finished we looked at the graph to find out if there were more who brought their lunch or more who were eating hot lunch. The students took turns counting the red squares (we had to check each other) so that I could put down the correct number to send to the kitchen. (They liked being helpful.) We also talked about how we could find out how many students were in the class by using the graph.

After a few days it really got to be a contest to see which column would be more. They even tried talking each other into either eating hot lunch or bringing their lunch, whichever column they were rooting for.

It turned out to be a good math experience and it gave me some time to get the lunch money counted!

All You Need Is a Deck of Cards

Terry Skrabacz

With just a regular deck of playing cards children can have hours of fun and learn something too. Most games we play with cards use some form of mathematical thinking. When children play card games they're enriching their skills in a happy and relaxed atmosphere without realizing it! Here are a few card games for children to try. Some of these will enhance their ability to order, classify, add and subtract.

"Greater Than/Less Than"

This can be two separate games. "Greater Than" is played by dealing five cards to each player and turning one card face up off the pile. The first player looks at the card face up. If he has a card that is one greater than it shows, he may place it on top of that card. If he doesn't have a card one greater, he must draw a card from the pile. "Less Than" would be played in the same way, only players must play a card exactly one (number) less than the card.

"War"

The card game "War" is still an excellent game to be played by children. If the game progresses at a good speed it causes children to think quickly. One variation would be to ask the children to compute the difference in their head.

For even younger children (4-6 years old) a game could be played where they would have to match colors. Deal out five cards and try to match the turned up card with a card in your hand. First person to run out of cards wins.

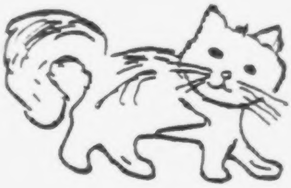
"Figure It Out"

"Figure It Out" is a game requiring thinking. It can be played with any number of children. Someone is to remove one card from the deck then lay them out face up. The object is to glance over the cards and see which one is missing from the deck. Or simply give a child a deck of cards with one or a couple of cards missing from it. It is interesting to see how they figure out which card is missing.

Sequencing games are helpful also. For example, a game where the children would have to alternate discarding red, black, red, black. There are a number of other sequences possible; sequencing by suit, number, alternating number and face cards, or evens and odds.

Concentration is a great thinking game. Lay out all the cards face down. Players turn over two cards each turn to try to make a match. When two matching cards are turned over, player may try again. Player with most matches wins. This game is helpful for creating mnemonics. (It is important to build on these memory devices because often children simply have to remember what they can't understand.)

Many mathematical concepts can be enriched through these games. It's much more fun for kids to learn them like this than to drill.



Eyes closing slowly
Kitten purring in my arms
lazy afternoon.

--Myrna Tucker

Grid Paper Math

Sharon Moser

This idea was presented to me by a math resource teacher, Mrs. Carol Hankins, in Alief, Texas.

Materials:

20 1 centimeter (□) squares of yellow paper to represent ones
20 10 centimeter (▭) strips of blue paper to represent tens
20 100 centimeter (▦) squares of red paper to represent hundreds

Put the above materials in a plastic ziplock bag.

These materials are used to teach students the concepts of place value, addition, subtraction, and whatever else you desire. Of course, centimeter wooden blocks would be ideal, but paper is less expensive and can get across the same idea.

In place value the teacher should start by having the students name ones (e.g. □□ = 2), then tens and ones (e.g. ▭▭□□ = 22) and then hundreds, tens, and ones (e.g. ▦▦▭▭□□ = 222). After that, see if they can give the correct number when you only have hundreds and ones, or hundreds and tens. These materials help students get a better concept of the number they are naming.

I used the centimeter paper to teach third graders in my low math group in Alief, Texas. After our class had studied place value using ones, tens, and hundreds, my students wanted to see how big thousands and ten-thousands would be in comparison to ones, tens, and hundreds. So my class and I took butcher paper and marked the hundreds to equal a thousand and then thousands to equal ten thousand. Our examples, from one to ten thousand were hung on the wall in the main hallway so others could see this discovery.

We also used the centimeter paper to do addition and subtraction. This is done by trading ten ones for a ten and ten tens for a hundred. For example, the students added 8 + 5 to get thirteen centimeter squares and then traded ten ones for one ten and so forth. The class did just the reverse in subtraction. This helped the students to better understand the idea of carrying and borrowing. The class could see how it worked out in action.

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All Out of the Alphabet

Sharon Moser

This is a game I created to develop vocabulary and observation skills. First, write out the alphabet from A to Z. Then underline all the vowels -- a, e, i, o, and u.

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

For this game, you can only use each letter once and you must use them in order from A to Z. For example, you can make the word belt because you started with b, used each letter once, and used the letters in order from left to right.

After students get the idea, you can offer several challenges.

Who can make the longest word?

Who can make a plural word?

Who can make the most words?

Who can make a word with the most vowels?

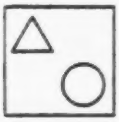
Who can make a word with the most consonants?

Which vowels are used most often?

Stamps

Gay Rasler

In our class Dr. O'Brien gave us this problem: A country is designing a new stamp. This is the stamp design:



The country is poor and cannot afford any other designs. Using red, yellow, and blue colors how many different stamps can be made? You may use one, two, or all three colors, but the whole stamp must be colored -- background, circle and triangle.

I presented this problem to my second grade class. I gave each student a blank ditto copy of the stamp. I explained all the directions and instructed the students to color their stamp how they wished. When they were all finished we went through all the stamps and taped them on the wall. We did not put up any duplicates. We ended up with seven different stamps on the wall. (There were 26 students in my class.)

I then laid a pile of blank stamps out. The students were directed to work on their free time to make more stamps that we did not already have. At the end of the second day we had 16 stamps on the wall. On the third day the students had trouble not making duplicates of stamps we already had. After a class discussion one girl suggested we arrange the stamps on the wall by background colors, put all the red backgrounds in a row, and all the blue backgrounds in a row, and all the yellow backgrounds in a row. At the end of the third day we had 24 different stamps on the wall. After four days the students had made all of the 27 designs possible.

Dogs and Cats

Betty Bledsaw

I had my class (fourth grade) write two paragraphs — one on how dogs and cats are alike, and one on how they are different. I watched the children while they were writing their paragraphs. The first paragraph was done easily by most of them. The second paragraph, dealt with differences, gave them more trouble. I could see contorted faces, wrinkled noses, and hair twisting and fidgeting. One boy was even going through the motions of climbing a tree. He then whispered to himself, "Cats climb trees and dogs don't." Another boy said after two or three tries, "I can't put down any differences."

In looking at the paragraphs, most of the children dealt with the looks, shapes, sounds, and habits of dogs and cats.

I have selected a few sentences from some papers to ask what the reader can make of these.

1. If there are likenesses, there must be differences.
2. Have you ever seen a cat bark or a dog meow?
3. How dogs and cats are different. (This is the child who said he couldn't put down any differences.)
4. how or dogs and cas different. A dog or different colors.
5. Dogs and cats have tails. And they both have fur. They have whiskers, eyes, nose, teeth, mouth, eyelids, ears, four legs. They have claws, and paws, tonge, they both breath, sleep, bits, scratch, beg, and talk.
6. They both have different names so they must be different.
7. They do different thing. Like a cat stay inside. And a dog stay outside. Dogs dug holes cats don't.

8. Like they both have tails.
9. They both like to be pet. Theyr's both mammals.
10. One is called a dog the other is called a cat.
11. A cat smaller. Dogs are much gentle.
12. they both make noises. they both have fur. or hair.
13. The both have different personality.
14. They both got four legs and two eyes a tail they both make a sound they can run there both playful and cute they can, be friends they have paws.

There you have it, reader. The sentences were copied just the way they were written. A tryout -- How about comparing a hen and a duck? or How about comparing a horse and cow? What would your class do with it? (Source for tryout came from a reading about a tryout Piaget did himself with children.)

* * * * * * * * * *

Teachers

Lisa Leardi

Teachers are nice but they make your desks clean,
   sometimes thier mean,
A teacher likes cake or strarberry pie,
   when thier happy sometimes they sigh.
But what teachers like best is for you to be quiet,
   so don't make it a riot.
So when you see a teacher don't relly stare,
   because you know thir going to have blond hair.

This poem was written by Lisa when she was a second grade student at St. Mary's School in Edwardsville.

Scavenger Hunt

Barbara Grigg

This is a good outdoor education lesson to help students become aware of properties and objects in their environments.

Materials needed: Sack or plastic bag
Notebook and paper
Ditto of objects to collect

Procedure: Students work in groups of two to write down observations and make collections.

Find the following:

1. 3 different shapes
2. a simple machine
3. 3 different colors
4. 2 different textures
5. animal trace
6. a manufactured material being weathered
7. colorful rock
8. monocot and dicot
9. edible plant
10. something recyclable

Record the following:

1. loud sound
2. soft sound
3. pleasant smell
4. unpleasant smell
5. live animal
6. 2 types of trees
7. 1 wild flower

Seeing Stars

Barbara Grigg

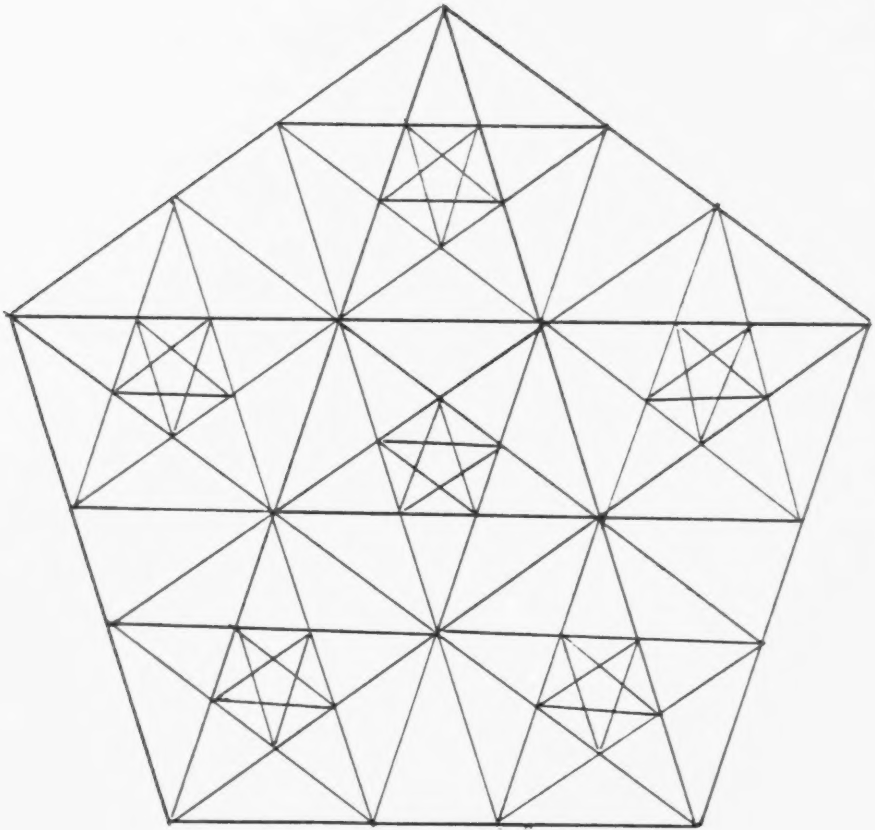
Find the hidden stars in the pentagon. Connect each vertex to two opposite vertices. This will make the first star.

Find the new small pentagon. Draw a star in the center of this pentagon.

Extend the arms of this small star to the edges of the big pentagon. You will now see five other small pentagons. Make a star in each of them.

Every pentagon has a star hidden in it. Keep drawing stars until pentagons get too small.

Color the design in an interesting way.

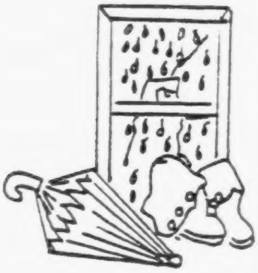


An Observation in Classification

Terry Skrabacz

While doing a lesson on classification with third graders one day, I noticed some interesting results. The lessons consisted of grouping the children into 4 (in each group) then giving them a few poker chips to classify. The chips were red, some blue, some with a piece of white tape on them, and some had a black dot on the tape. I knew in my mind how _I_ would classify them. The first division was obviously red and blue. The next was plain chips, then chips with tape on them and finally chips with a black dot on the tape. But the lesson did not flow this smoothly. First of all, the children weren't interested in what would clearly separate the two groups (set them apart, differ). They were looking for "sameness" -- things that were the same. Many said that this is easier for them. Maybe it is easier to see the "same" characteristics than the "differences."

Pitter Patter



Rain is a-pattering
Out of the foggy grey sky.
Maybe it is God calling,
Or maybe it is God crying.
Because the people of his planet
Can't live together in peace.

--Jenny Nehrt

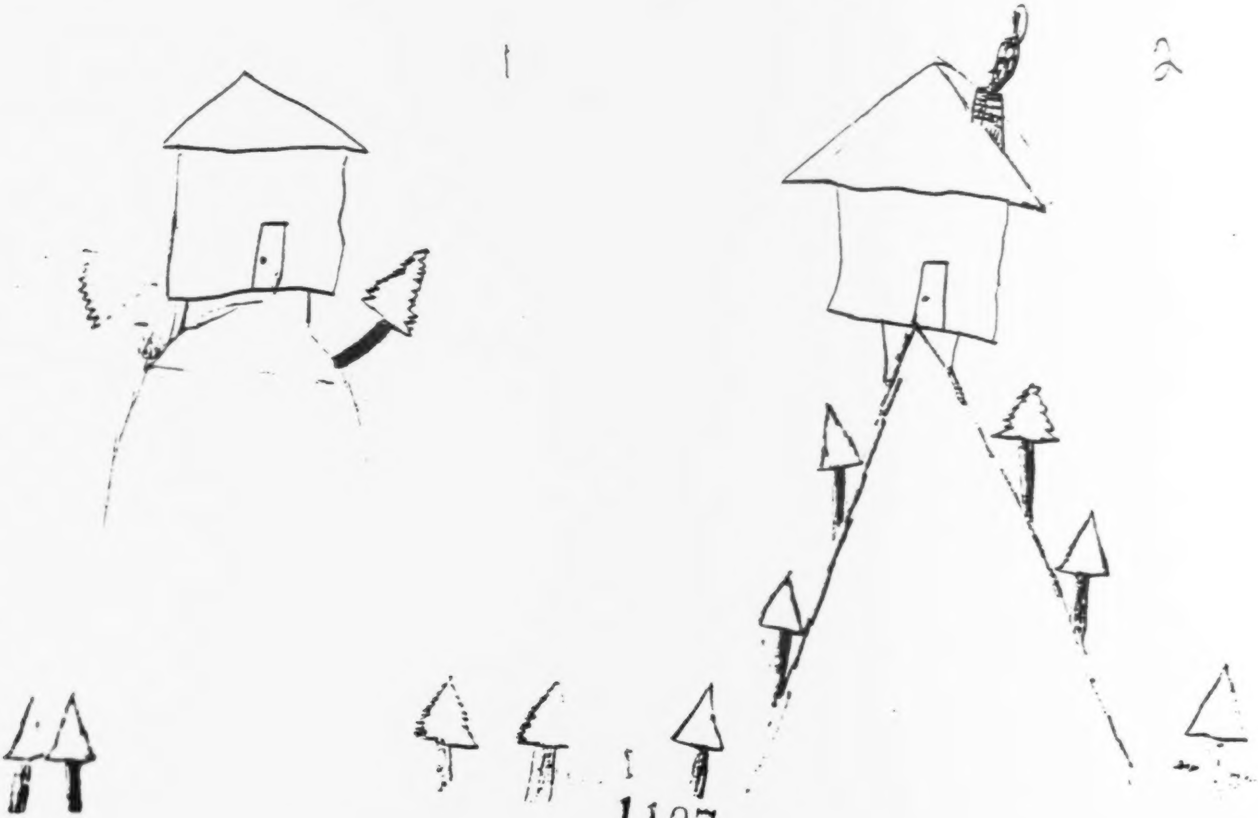
Conversation About Mike's Trees

Pat Young

In the last few weeks, we have been looking at children's drawings of hills, trees and houses to get an insight in the thinking of those children. With my curiosity aroused, I asked Mike to draw a hill, house and six trees. Mike is nine years old and in third grade.

When Mike had drawn the first picture, he showed it to me and we talked about trees and houses. I never commented on right or wrong. He said he had never seen trees grow sideways and asked if he could redo the picture.

I think that Mike, through his own oral language, had realized what was wrong. He said the trees in his drawing were wrong. Is it possible that if a child is allowed to talk about his work he can become a more mature thinker?

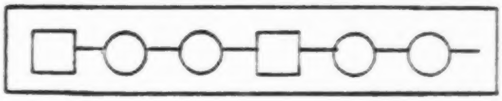


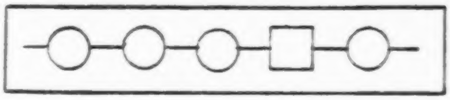
Starting with Bead Patterns

Carole Moeller

Make up several pattern cards -- pattern left to right.

Example:





Children are to select a card, then using yarn, shoestrings, and wooden beads, try to make the pattern as shown on the card.

Use 3 basic colors

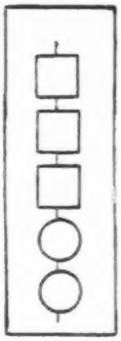
□ square beads blue

○ round beads yellow

⬯ oval beads red

(Children will unconsciously count also)

Vertical cards used for addition



3 + 2 = 5

2 + 3 = 5

Then as they unstring they will subtract.

But What's the Use of Asking Kids To Have the Computer To Draw a House?

Catherine Berdonneau

This is a dialogue between a parent (P) whose child is working with LOGO at school, and a member (L) of the French LOGO Research Group.

The LOGO Project came from a common concern of researchers in Artificial Intelligence and in Education about what could be expected of computers in education. The work started in Cambridge, Massachusetts. Since the late '60's the Project grew, including various disciplines (mainly mathematics, music, physics, biology, grammar...), and extending to various countries (Canada, Scotland, Australia, Germany, France...). The word LOGO denotes at the same time a theory of learning, a programming language, and a set of computer-controlled pedagogical devices.

The children talk a lot about LOGO when they come home, but not always in a very understandable manner to their parents. For instance, they refer to the turtle, which can either be a robot crawling on the floor (protected by a dome), or a small triangle on a television screen. One makes this "turtle" move with very simple orders: FORWARD, BACK, RIGHT, LEFT: the turtle has a pen which can be in an upward position (so that moving the turtle does not leave a trail) or in a downward position (so that one can make the turtle draw designs).

One of the favorite projects of the children -- be it in the States or in France -- is to have the turtle draw a house. Hence the question:

(P) But what's the use of asking kids to have the computer to draw a house?

(L) First of all, they are not asked to draw a house, they are completely free when they make up their project.

(P) What is a project?

(L) It is "something" a group of children decide to realise with the computer. They are responsible for the choice of the subject. To find an idea is seldom a problem: they generally have too many ideas, and one of the first difficulties is coming to an agreement, either by making a synthesis of each child's suggestion or by a subtle negotiation among the group. The way they carry out their project also is up to them. And last but not least, they take the decision to consider the project as completed at some time.

What I find particularly interesting is that there is a very large variety of houses. Focusing only on the second grade class I observed this year, we find a flat, a terrace roofed house as in hot countries, and a very traditional house with a pointed roof. None of these houses looks like the ones we had last year with fifth graders. But not only do the shapes vary, but also the methods to have the computer draw the design differ. For the terrace roofed house, kids respect the chronological order, building the walls first — a square -- and then doing some carpentry for the roof. Fixing the roof on top of the house is not at all simple. On the contrary, the building defies all gravitation laws, since the roof is attached to the first wall before the opposite wall comes back to the ground level, where the floor is drawn at last!

(P) Anyway, it would be much simpler to use a sheet of paper and a pencil to draw a house!

(L) Neither for us nor for the kids is the goal to draw a house. Our objective is to provide the pupils with an environment and a tool which allows them to be responsible for what they learn. The adult is not the one who possesses and transmits knowledge, but a pedagogue in the etymological sense of the word, the one who leads the child, in order to help him follow the most fruitful path in his travel toward knowledge. Children do somehow feel this, and above all intend to make the machine obey them. They are thus brought to think about what their reasoning produces, as the machine shows it, the computer being kind of a "mirror of their thinking".

(P) But do they learn anything?

(L) Let us analyse a few specific projects, all dealing with houses.

The Orange Flat[*]

Starting on an idea suggested by one's usual surroundings, the first task is to come to a simpler figure:

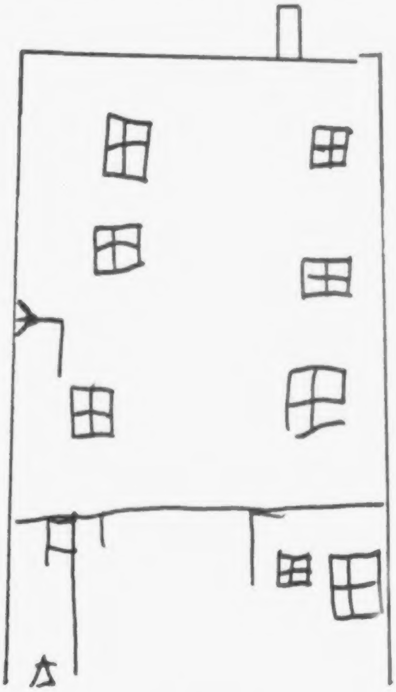


FIGURE 1

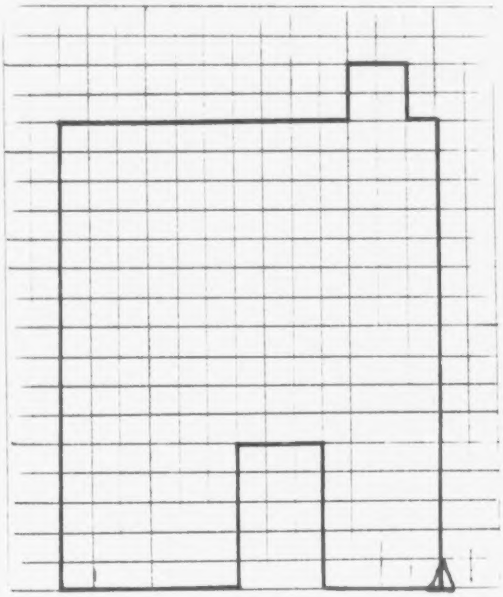


FIGURE 2

This means making choices among a multitude of details, keeping only the most important ones and forgetting all those which are not really meaningful.

---

[*] Each group keeps all its work in a folder of a specific color, and gets referred to, even in class, by the color of this folder.

1 square = 3 turtle steps

```
FD 48
LT 90
FD  3
RT 90
FD  6
LT 90
FD  6
RT 90
BK  6
LT 90
FD 30
```

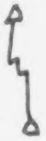
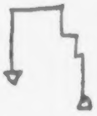


FIGURE 3

Then one has to determine a scale and use some technique for counting. Do not forget that these children are second graders, a level where multiplication is still unknown.

Thus they use a translation method, reciting the rhyme on two tones: one, two (in a whisper) three (with a louder voice), four, five, six, . . .

```
FD 80
LT 90
FD  5
RT 90
FD 10
LT 90
FD 10
RT 90
FD 10
LT 90
FD 50
LT 90
FD 80
```



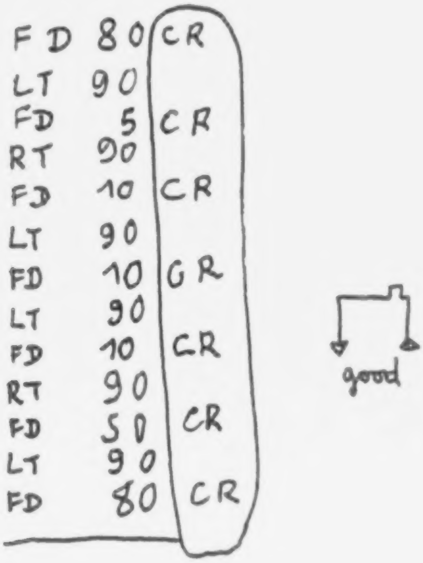
1 square = 5 turtle steps

FIGURE 4

This results in a very tiny figure. They change their scale and also adopt a new technique (which is a very good preparation for multiplication). Instead of iterating a translation, they use a repeated addition: five (for the first quare), plus five is ten, plus five . . . .

Since reciting the rhyme, as well as adding, are not completely mastered at this level, it often results in discussion, or even strong disputes, regarding the results (be they right or wrong).

Distinguishing between right and left(**) causes unpredictable shapes for the building, which provide occasions for laughter. The chimney, especially, is very hard. So what satisfaction when the desired pattern is obtained!



```
FD 80 CR
LT 90
FD  5 CR
RT 90
FD 10 CR
LT 90
FD 10 GR
LT 90
FD 10 CR
RT 90
FD 50 CR
LT 90
FD 80 CR
```

FIGURE 5

The Red House

On the opposite of the previous building, which was described sequentially, the red house is from the very beginning thought to the end product in a structured way.

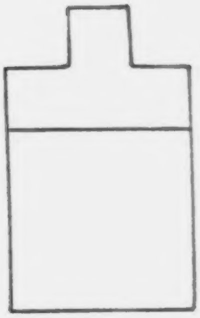


FIGURE 6

In fact, this group chose as their first project to draw a square with a sideoof 100 turtle steps. They decided, for their second project, to use this object. The reason for the odd shape of the roof is the instructions we gave the class for their first projects (the only restriction imposed on their imagination): "Choose a design which follows the lines of your grid paper".

Putting the roof on top of the walls requires several attempts. The logic of adult builders does not necessarily match the children's logic and after having separately prepared stone-work and carpentry (pre-fab is useful here too!), they try

ROOF

SQUARE

but the turtle doesn't have enough room on the screen to draw the second side of the square, and returns the message:

OUT OF BOUNDS

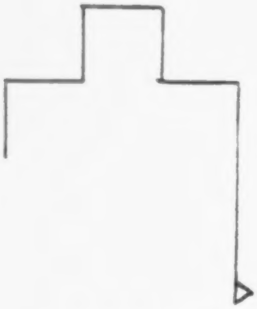


FIGURE 7

So they try reverse orders. (One of the girls warns the group, "This is going to cause a massacre.")

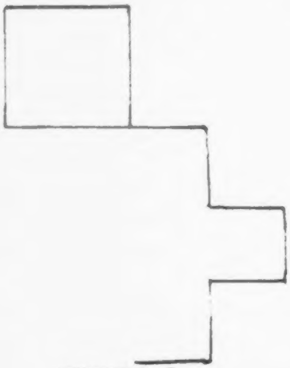


FIGURE 8

During the next class, they only stay a very short time at the computer, just to try:

SQUARE

LEFT 90 FORWARD 100

ROOF

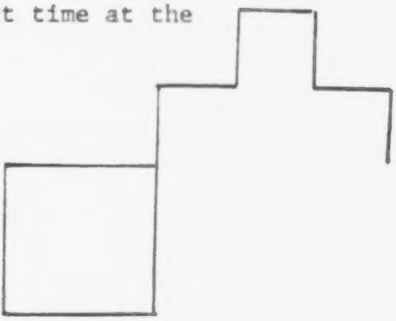


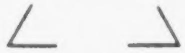
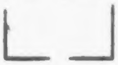
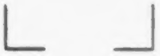
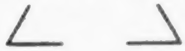
FIGURE 9

No doubt, it's improving! Next week, the girls notice that the square is smaller than the roof. They consequently build a new square with 150 step side. But again they get an "out of bounds" message. This time, a boy makes the group move ahead, suggesting that they start the square backward. He therefore obtains one wall and the floor with

BACK 150 ROGJT 90 FORWARD 150

but the command RIGHT 90 they typed faces the turtle in the wrong direction. He balances this with LEFT 180, thus denoting a real mastery of some properties of the rotation group. At that point, he is the only one having such a mastery of this topic, and the others will need many more sessions watching how this works before they will be able to do the same.

The Pointed Roof House

The same group now skips to a pointed roof house. A first problem is overstepped with the determination of the value which puts the turtle in the right position for the roof pitch. One of the boys explains, using his hands to express his thoughts: "For the roof, it's like that  , so you just need half of this  . Since this  is 90, then this  is going to be 45."

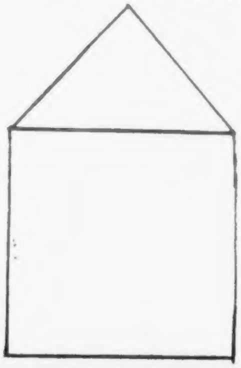


FIGURE 10

Meanwhile they also enriched the masonry with a door. The roof will bring new problems to solve, such as angles in a triangle, side length in a triangle. . . They generally solve these kinds of problems in a successive approximations way, which is a general method widely and fruitfully used in mathematics and often not used in schools.

(P) Then, it is useful to let them have a computer draw houses?

(L) Yes, indeed: instead of contemplating mathematics, they make it.

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Brian Luebbers
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Carlyle, Illinois

Jenny Nehrt
Carlyle Junior High School
Carlyle, Illinois

3.15 4.45 6.70 10.45

Name ____

NO SUBSTITUTIONS

AWAY FROM BASAL TEXTS

3.90 5.50 8.20 12.55

NO SUBSTITUTIONS

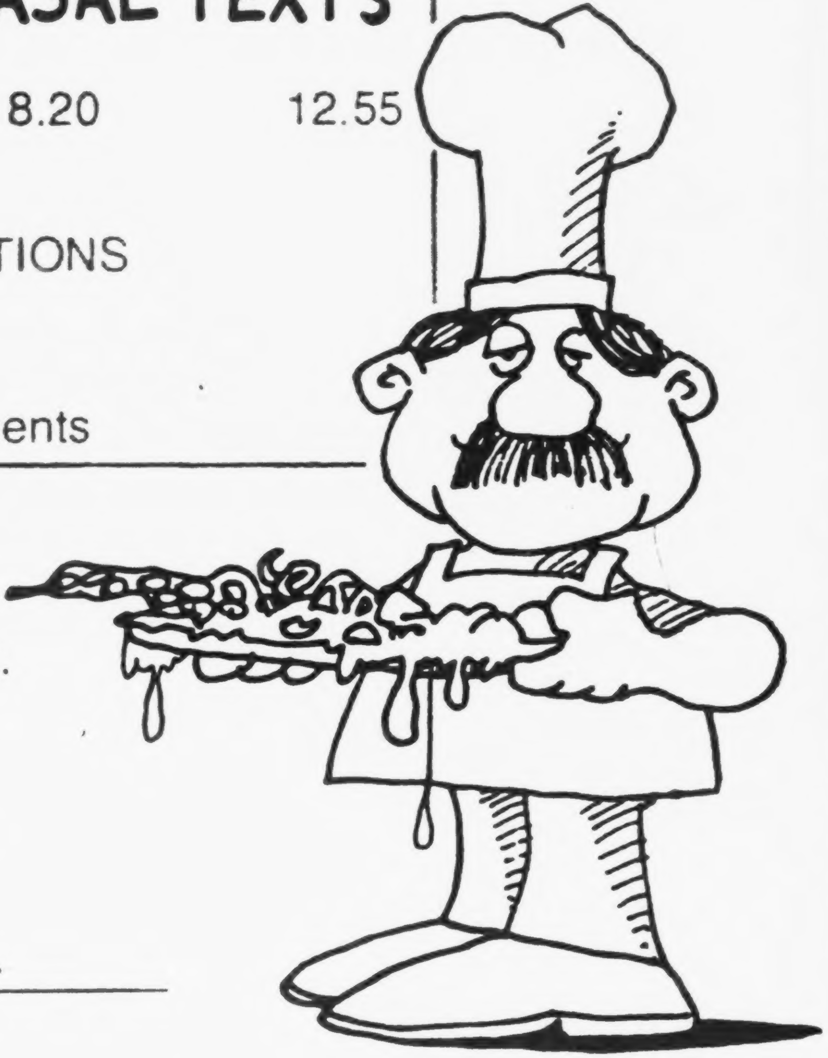
XTRA CHEESE add 50 cents

20 to spend.
izza can you buy?
? Assume there is no tax.

rooms ____ ____

ni and olives ____ ____

usage and extra cheese ____ ____



Special Issue

SEEDBED

AWAY FROM BASAL TEXTS

SEEDBED

A SPECIAL ISSUE

August, 1982

Teachers' Center Project

SIUE

Southern Illinois University
at Edwardsville

INTRODUCTION

In spring of 1982 I had the chance, between sessions at a conference in Urbana, to take a long look at the basal elementary math texts available to teachers. I had not taken such a look in five years or so.

Several of my textbook editor friends had said from time to time, "Tom, I can't look at the mirror when I shave in the morning. I'm ashamed of what I'm doing professionally. But what sells, sells." Even with such warnings, I was not prepared for what I saw.

The books, virtually without exception, could easily have been produced in 1910. Yes, the graphics and the photos were modern -- a lot of attention seems to have been given to cosmetic issues -- but the stuff in the books was not. The books were appallingly bad.

I will not use this space for a lengthy criticism. The Teachers' Center Project has some eighty publications on children's mathematical growth and if the reader would take a look at just their recently published "Toward the 21st Century in Mathematics Education" and "What's Basic? A Constructivist View" (recently published by the National Institute of Education) the point will have been made. Suffice to say that a mathematics curriculum totally given to computational proficiency is preparing children for a world that no longer exists.

The point of "Away From Basal Texts" is this: There are, in fact, a lot of decent printed materials for children to engage. Many of them come from small publishers which may be quite unknown to teachers. They deal with real mathematics of importance to children. They invite exploration, problem solving, and thought. They permit small groups of children to work together, to choose this problem and not that one, to be active in the learning of mathematics.

What we wanted to do, then, is simply to make it known that there are alternatives to basal texts. And we wanted readers to have a glimpse of what some of these alternatives might involve.

"Away From Basal Texts" is a sample of some of the better print materials available to teachers these days. It is by no means an exhaustive sample. What we hope is that given such an appetizer, teachers will follow up by ordering some of the books, writing for catalogs to find out what else is available, and generally moving toward quality in math education.

A list of publishers' addresses is given at the end of the book. The ball is in your court now.

We are grateful to the publishers whose works are represented here (and to those others whose materials are not included for space reasons) for their cooperation, their granting of permissions to reprint selected samples, and their provisions of complimentary texts for this project.

Thomas C. O'Brien

Shirley A. Casey

Shirley A. Casey

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Sorting on the Overhead Projector

SKILLS

Observing and describing properties of objects
Noticing similarities and differences
Thinking logically
Making predictions
Drawing conclusions

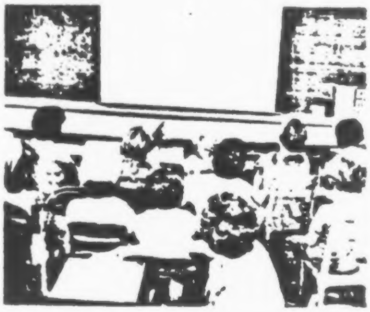
MATERIALS

Geometric shapes (see Worksheets 20–21) for the overhead projector*

ACTIVITY

The teacher defines the categories by which the children are to sort the shapes. Then the children respond to the teacher's questions indicating whether or not a shape can be placed in a group.

SAMPLE TEACHING STRATEGY

TEACHER	CHILDREN
The teacher puts three squares together and three circles together on the overhead. Taking an additional square the teacher asks, "If we want to put all the squares together and all the circles together, can this go here?" 	"No."
"Can it go here?" 	"Yes."

INTRODUCTION

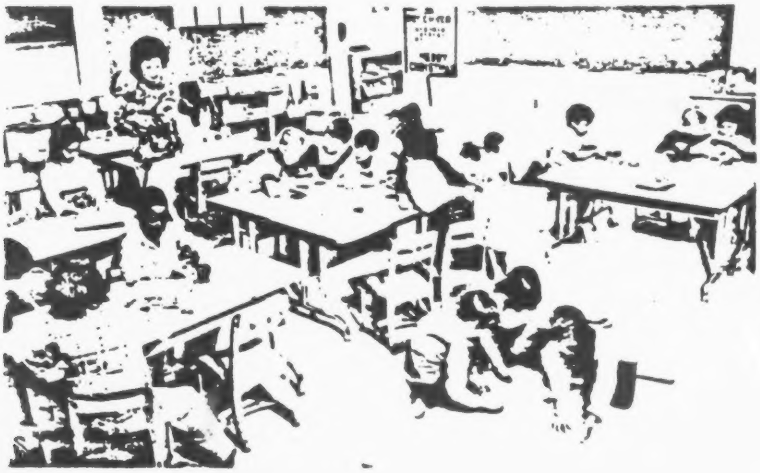
Sorting and classifying are fundamental parts of life. People use sorting when determining what kind of a dog they see, when recalling a politician's name, or when getting another person a screwdriver. People use sorting when they put away the dishes, select cat food at the grocery store, or pick out the appropriate coins to buy an ice cream cone.

The importance of sorting and classifying activities in children's mathematical development is critical. Through these activities children learn to think analytically and to express their thoughts clearly. Forming classes and dealing with the relationships within a class and among different classes encourages the growth of clear and logical thinking, which is the basis of good mathematical reasoning.

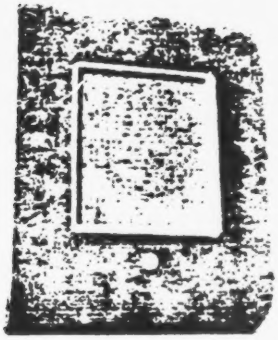
In order to sort and classify a group of objects, a child must recognize what is called an *attribute*. This is an intangible idea describing a particular property which some objects have in common. To sort some of the objects, children focus on one property the objects possess to the exclusion of the others.

Describing the attribute with words labels the groups that have been sorted and placed together.

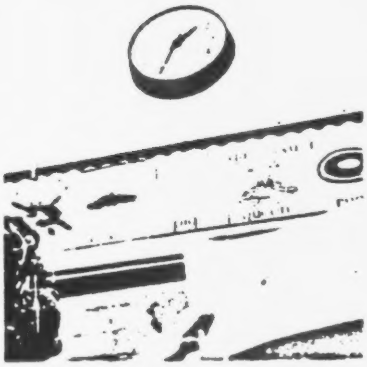
The activities in this chapter give children a wide variety of experiences in sorting and classifying with both structured and unstructured materials. The children sort geometric shapes, junk boxes, materials from the natural environment, one another, geoboards, and other commonly available materials. Each material is sorted in a variety of ways and the necessary vocabulary describing the relationships of size, shape, color, texture, and other properties is developed concurrently.

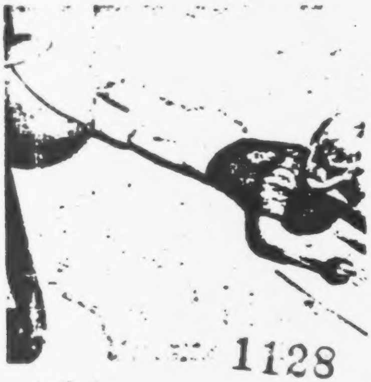


after a few weeks. Seven-and-eight-year-olds could start at the second level and then on an individual basis choose when they want to try the third level.



"Round"





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Sorting and Classifying Walks

SKILLS

Connecting an abstract idea to the real world
Selecting objects with a particular property
Comparing
Making judgements
Stimulating visual imagery
Using all the senses to gain information

MATERIALS

Paper and crayons (optional)

ACTIVITY

This activity basically involves going for a walk with a purpose in mind. There will be greater opportunity for language development if you arrange for volunteers or older children to come along and form the children into small groups. Before leaving the classroom, decide what the children are going to look for, listen for, or collect.

This activity should be repeated many times, changing the focus of the walk each time. Children might look for: diagonal lines, straight lines (both vertical and horizontal), curved lines, squares, triangles, rectangles, anything green (or any other color), things made of metal (or glass or wood or plastic), things that move, things that are rusty, things that look new, signs with numbers, signs with words, different vehicles (cars, trucks, vans, buses, tractors), rough-textured things, delicate things, old things, things that are wet, sounds heard in different places (in the office, in the hallway, in the cafeteria, on the playground, in the classroom), things that are bigger than ______ (or smaller than ______), and things that could be held in one hand. The possibilities are limitless.

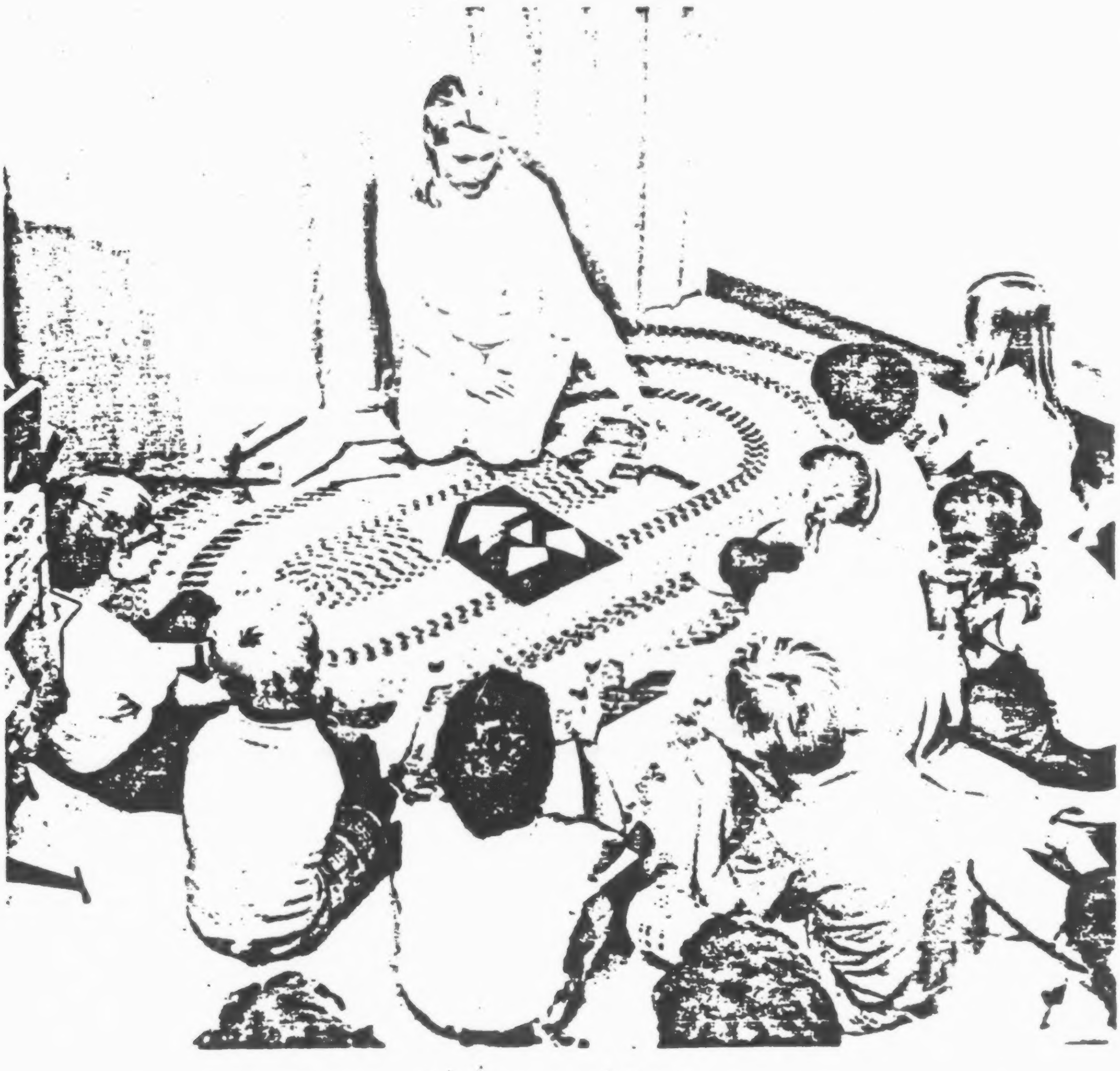
Sometimes the children should just *talk* about the things they found with the particular attribute. At other times the children should take paper and crayons with them so that when any of them notices something yellow (if that is the appropriate attribute) sheorhe can stop and draw a picture of the object while the rest of the group continues searching. When the child is finished drawing, sheorhe can catch up with hisorher group. Back in school, the children make a class book of their drawings for the attribute explored on the walk.

At other times the children should go on a sorting walk and when they *return* to class, draw from memory what they noticed with the attribute.

These alternatives represent three different levels of abstraction and skill. Five-year-olds might only talk about what they find, remaining at the first level all year. Six-year-olds might start at this level but feel comfortable at the second level question by glancing at the cubes. Observing which children do and which do not yet abstract the rule used is a good opportunity to watch the idea of sorting and classifying develop.

When all the shapes have been placed, erase the star from the chalkboard and talk about the attribute used to create each group. Ask the children such questions as, "Did I care about the color when I sorted this time? Did I care about the shape? The size? The thickness? Are there any shapes on the white paper that are not on the black paper? Where are all the shapes that are not triangles?"

Repeat the activity many times, sorting by thick and thin shapes, by blue and other than blue shapes, squares and other shapes, and by large and small shapes. Consider using two attributes and varying one; sort small blue shapes and large blue shapes, thick red triangles and other thick shapes, large red rectangles and small red rectangles, etc.



APPLICATION AND EXTENSION OF SORTING AND CLASSIFYING

The following activities allow the children to explore sorting and classifying in a variety of ways—sorting by given categories as well as guessing the categories used for various sortings, observing attributes in the environment, in children's clothing, and in their names. These activities should be spread out over the year and be repeated many times. As children's skill increases, the same activity becomes a new experience and is carried to a new depth of understanding.

Read My Mind

SKILLS

Analyzing and describing the common properties of a group of objects
Noticing similarities and differences
Problem solving
Thinking logically
Making predictions
Organizing information

MATERIALS

Geometric shapes* (see Worksheets 20-21), a black and white Unifix cube for each child, one piece of black construction paper, and one piece of white construction paper

ACTIVITY

Explain to the children that this is a silent game and put a star on the chalkboard as a signal. No one is allowed to talk until the star is erased, not even the teacher!

Place some shapes on the white construction paper and some other shapes on the black construction paper according to certain common attributes. Hold up a shape you are about to place and indicate first one pile and then the other, looking questioningly at the children. The children try to read your mind and predict where you will place each additional shape. When the children have predicted with a Unifix cube, place the shape in the appropriate group.

Continue in this fashion until all the shapes are placed. Because this is a silent game, each child has the opportunity to think for himself or herself. The teacher can tell at a glance which children have discovered the attributes in

GEOBOARD AREA AND PERIMETER

1. MATERIALS NEEDED:

Geoboards

Rubber bands

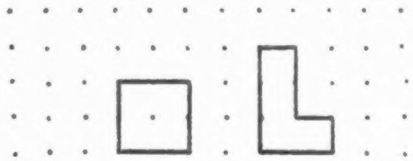
Dot paper

2. Use rubber bands to fence in sets of four square units on the geoboard. Do not connect diagonal nails. Do you know why?

Measure a unit side and a diagonal length and report your findings.

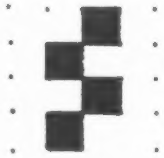
3. Make a sketch of each different figure on dot paper.

EXAMPLE:



4. Shade in the area of 4 and write the perimeter under each drawing.

EXAMPLE:

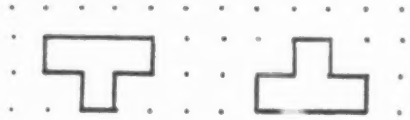


Area = 4 sq. units

Perimeter = 16 units

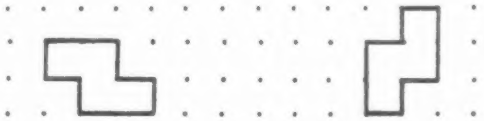
5. How many different arrangements can you make?

These two are the same because they are reflections.



6. If you can rotate one of your figures to get another, they are the same.

EXAMPLE:



7. What was the smallest perimeter you found? ______

What was the largest? ______

8. Choose another area number and see how many different perimeters you can get.

Make a chart of your areas and perimeters.

INVESTIGATING THE TRIANGLE 4

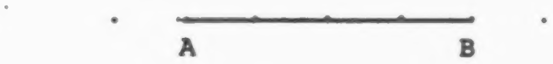
1. MATERIALS NEEDED:

   Geoboard

   Rubber bands

   Dot paper

2. Connect two nails (A and B) with a rubber band on the geoboard four units apart.



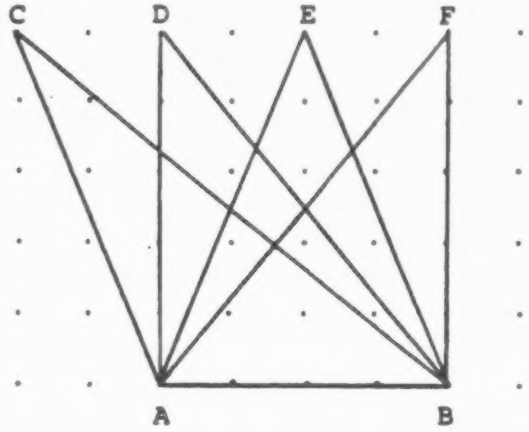
3. Count up 4 units and identify the line of nails that is parallel to the base.

   Connect rubber bands as shown to form triangles.

   Make a copy of the triangles that you have formed on dot paper. Label the vertices.

   Compute the areas and perimeters of each triangle.

4. EXAMPLE:



5. What is the area of:

   Triangle ABC? ________

   Triangle ABD? ________

   Triangle ABE? ________

   Triangle ABF? ________

   How do the areas compare?

   Why?

6. Use a cm ruler to find the perimeter of each triangle.

   Perimeter of triangle ABC ____

   Perimeter of triangle ABD ____

   Perimeter of triangle ABE ____

   Perimeter of triangle ABF ____

   Which triangle has the smallest perimeter?

   Why?

IRREGULAR POLYGONS

1. MATERIALS NEEDED:

cm ruler

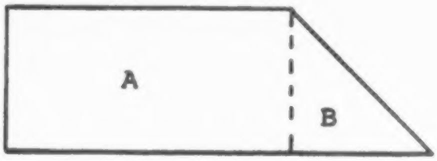
Clear plastic grid

2. For each of the following polygons, draw lines inside to form simpler figures such as rectangles and triangles.

Find the areas of the separate regions in each polygon.

Measure around for the perimeters.

3. EXAMPLE:



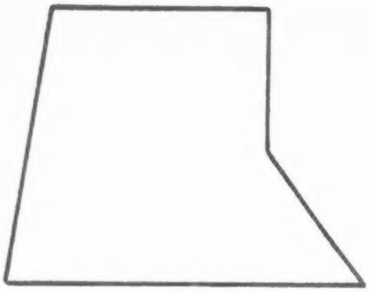
Area of A = 8 cm^2

Area of B = 2 cm^2

Total Area = 10 cm^2

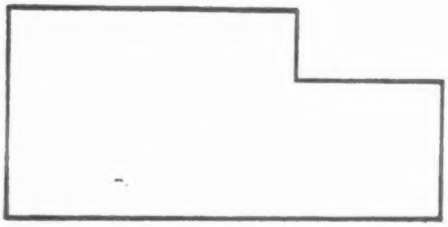
Perimeter = 15 cm

4.



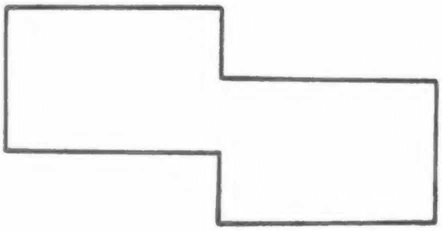
Area = ____ Perimeter = ____

5.



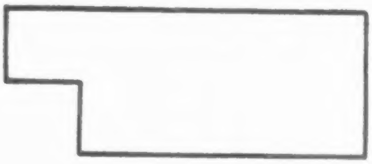
Area = ____ Perimeter = ____

6.



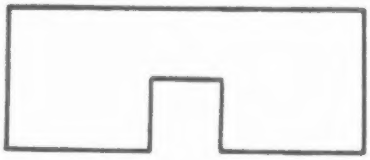
Area = ____ Perimeter = ____

7.



Area = ____ Perimeter = ____

8.



Area = ____ Perimeter = ____

CUBES: VOLUME AND SURFACE AREA

1. MATERIALS NEEDED:

   Assembled cubes

   cm cubes

   Scissors

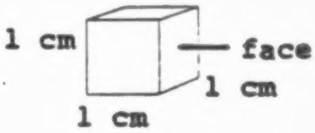
   Glue

   cm paper to make more patterns

2. Cut out the patterns of the 1 cm, 2 cm and 3 cm cubes and assemble.

   Fill the 2 cm and the 3 cm cubes with 1 cm cubes to find the volume. Record on the chart below.

   Count the number of squares on each face of each cube to find the surface area. Record on the chart below.



How many 1 cm cubes will fill a 1 cm cube? ___

How many 1 cm squares on one face? ___

How many faces has a 1 cm cube? ___

	VOLUME			SURFACE AREA		
SIZE	VOLUME	CUBES ON BOTTOM LAYER	NUMBER OF LAYERS	SURFACE AREA	SQUARES ON ONE FACE	NUMBER OF FACES
1X1X1						
2X2X2						
3X3X3						
4X4X4						
nXnXn						

intersecting circles

In this section we explore two ways in which a circle may be enlarged. The first generates all circles which have the same centre and the second generates all circles which touch a line at the same point.

The intersection of two sets of such circles forms the main theme. The loci of the points of intersection of two families of concentric circles is a straight line when the circles are equal and grow at the same rate, a circle when they grow at different rates and a hyperbola when they grow at the same rate but are unequal.

The relationship between this type of motion and one where two equal circles move towards each other is mentioned briefly.

A final sequence explores the locus of the intersections of two sets of circles which each touch a line at the same point. This situation is particularly rich and yields many well-known curves.

8 5

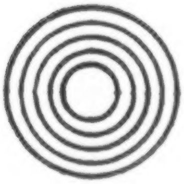
concentric circles

Imagine a very calm and still pond.

A small pebble is dropped into the water.

A small ripple is formed.

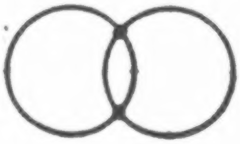
What shape is it?



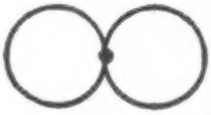
It grows bigger and bigger and bigger.

Imagine it can go on growing as big as we want it to.

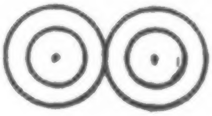
two families



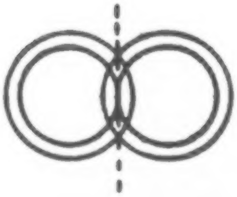
Think of *two* sets of growing circles. Let them start at the same time and grow at the same rate.



Somewhere they will meet!



And go on crossing each other. Concentrate on these meeting points.



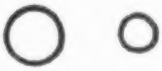
What is the path of the meeting points as the circles grow larger and larger?

Try to imagine very, very large circles.

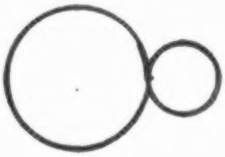
Where do they meet?

How big can you let your circles grow?

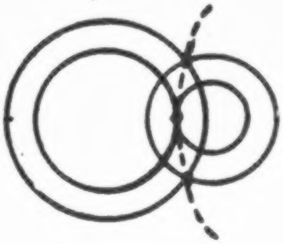
Intersecting circles



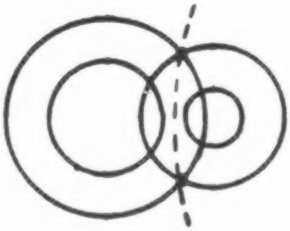
Again, let two sets of growing circles begin at the same time but let one grow *twice* as fast as the other.



They will eventually meet.



Let them continue growing. Where do the points of intersection lie?

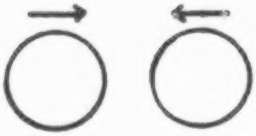


Try it again using a different rate - let one circle grow 1½ times faster.

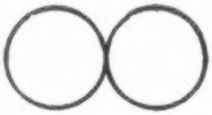
Can you predict (and describe fully) the path for any rate?

Does the distance between the centres make any difference?

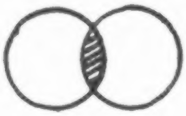
Try doing these with staggered stones.



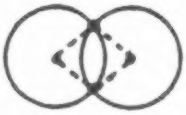
Imagine two equal circles moving towards each other.



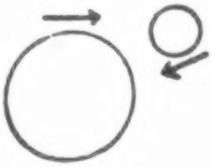
Let them overlap and pass over each other. Consider the changing shape of the intersection.



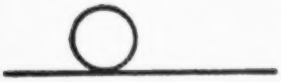
Consider the changing shape formed by the two centres and the two common points on the circumference of the circles.



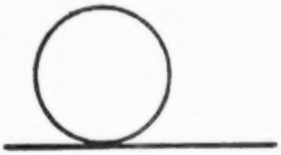
Consider different size circles and different directions of approach.



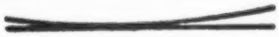
touching circles



Think of a circle sitting on a line.



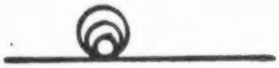
Let your circle grow bigger still sitting on the line.



Let your circle continue to grow.

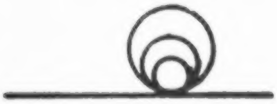
How big can you make it grow?

Where is its centre?

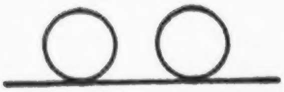


Now let your circle grow smaller and smaller.

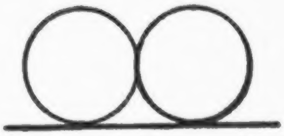
How small can it become?



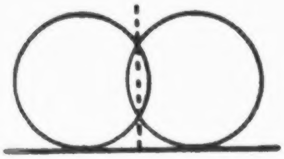
What happens to its centre? Now let your circle grow bigger on the other side of the line. What is the path of the centre of the circle?



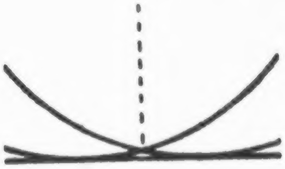
Imagine a line. Let two equal circles sit on the line, not touching or intersecting each other. Now let the circles grow at the same rate until they touch.



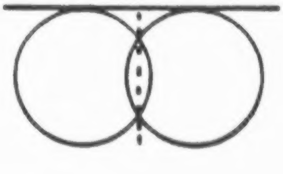
Let them continue growing, concentrating on their points of intersection



What happens when the circles are very big?



How big can you make your circles grow?

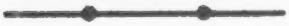


Let your circles grow small and then grow underneath the line.

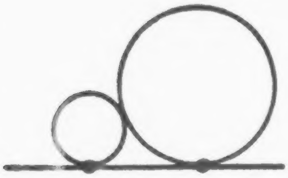
What is the path of their intersection?

on a line

Imagine two points on a line.



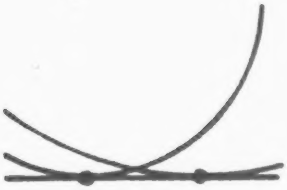
Let circles grow from each point so that they sit on the line but this time make one grow twice as fast as the other.



Where do they first meet?

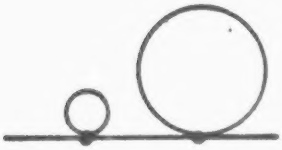
What is the path of their intersection as they continue growing?

What happens when they are very big?



Does it make a difference if they start closer or further apart?

What happens for different rates of growth?



Imagine two unequal circles sitting on a line.

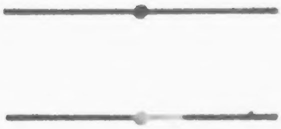
Let them grow at the same rate. One will always remain bigger than the other.

When do they first meet?

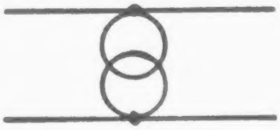
What happens when they become very big?

What difference do the starting positions make?

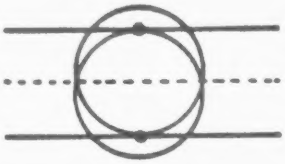
on two parallel lines



Imagine two parallel lines.

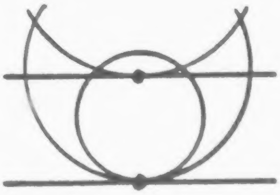


Let a circle touch one line and let another circle touch the other line opposite the first circle.

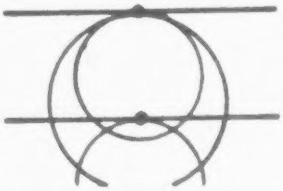


Make the circles equal and then let them grow towards each other at the same rate, still touching their lines.

Where do their intersections lie?



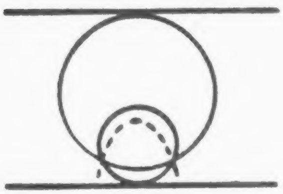
Can you make the circles grow in the same direction?



Where do their intersections lie now?

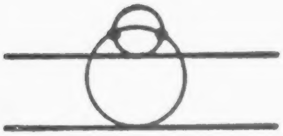
intersecting circles

on two parallel lines



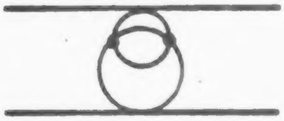
Again let circles grow from two parallel lines along the same centre line. This time let the circles grow at different rates.

What are the paths of the possible intersections above and below the lines?

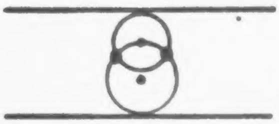


What effect does the distance between the parallel lines have?

What happens for different rates of growth?



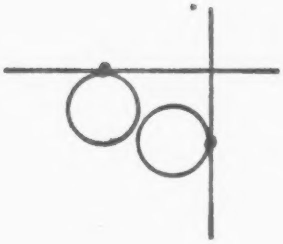
This time let the circles grow at the same rate but start them at different sizes.



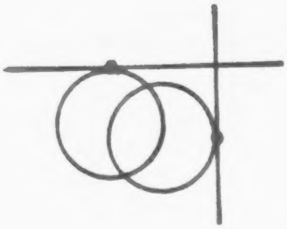
Let the circles grow in such a way that one always passes through the centre of the other. What are the paths of the possible intersections above and below the lines?

Some of the dynamics suggested in this section are shown in the film *Definitions of the right strophoid*, by J Nicolet.

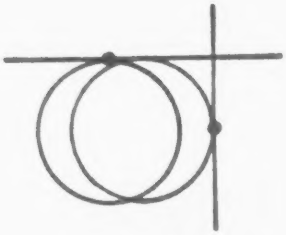
on two perp. lines



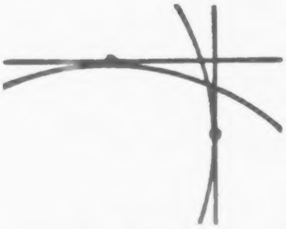
Imagine two lines crossing at right angles. Let a circle grow from each line. Make the circles equal and grow at the same rate.
Where do they first meet?



Where do their intersections lie?



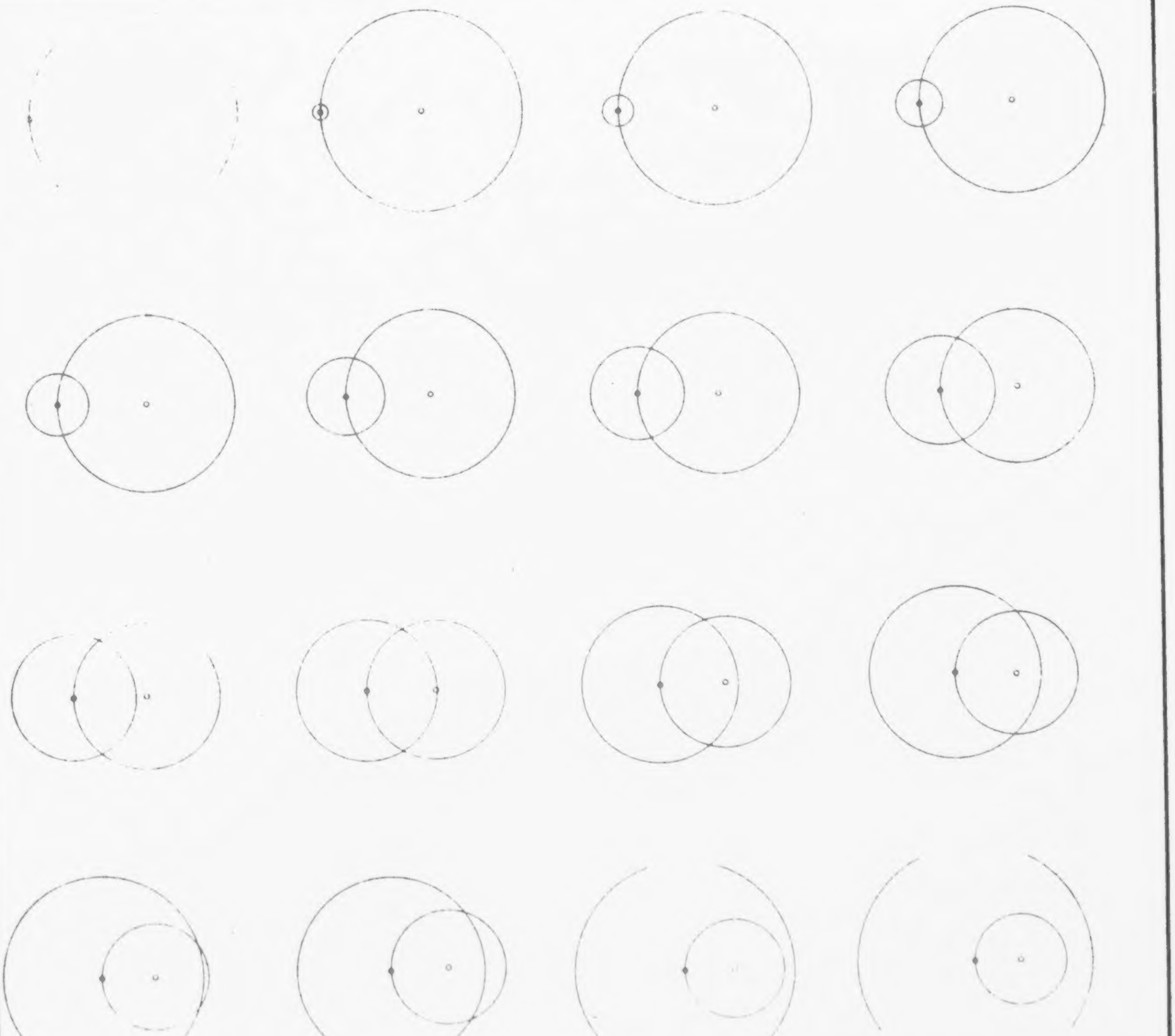
What difference does the starting point make?



What happens when they both grow from where the two lines cross.

Consider the situation when the circles are equal but grow at different rates.

When the circles are unequal and grow at the same rate.



A sequence of frames from a flicker book, **Leaves** *(published by Leapfrogs, 1976) displaying* **twelve** *miscellaneous transformations.*

3. NUMBER CELLS

In this row of cells you start with 3 and 4

3	4			

Then you add 3 and 4 to get 7, then 4 and 7 to get 11, ...

3	4	7	11	18

but if you are given the first and last numbers only ...

8				52

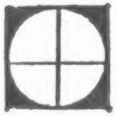
What are the missing numbers?

For different first and last numbers, investigate ways of finding the missing numbers.

Extend to other lengths of cells

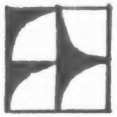
24. QUADRANT TILES

Draw a circle in the middle of a square.
Colour the corners and cut into four equal pieces



Each of the four tiles now has an identical coloured corner. Arrange the four tiles in a square pattern in any way you like:-

for example

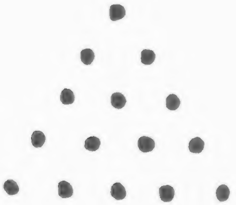


Repeat the same pattern side by side to make an overall design.
The pattern must be the same way round, not reflected or rotated.

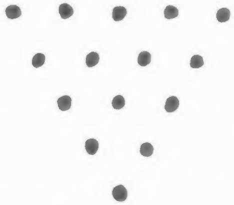
Investigate how many different overall designs are possible.

38. MOVING ARROWHEADS

An 'arrowhead' can be made out of counters



Its direction can be changed by moving only 5 counters:



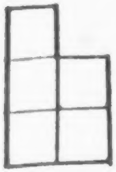
Investigate puzzles of this kind.

39. AIRLINE LUGGAGE

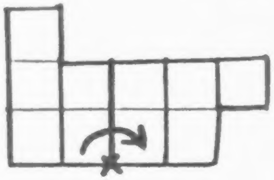
International Airline Luggage Regulations state:
"Passengers can take any piece of luggage where the sum of the 3 dimensions (length, width and height) do not exceed 105 ins (or 2·70m)"
Investigate.

40 TESSELLATING PENTOMINOES

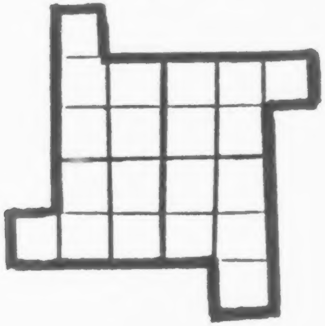
Choose a pentomino, say



Turn it through 90° about one corner



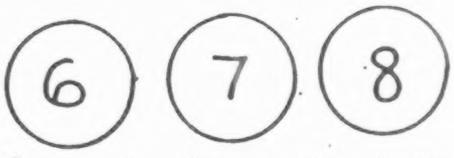
and again, and again



Investigate tessellations of these new shapes

12. DISCS

a)



Here are three circular cardboard discs.
A number is written on the top of each disc.
There is also a number (not necessarily the same) written on the reverse side of each disc.

Throwing the discs in the air, and then adding the numbers on the faces, I have produced the following eight totals :

15, 16, 17, 18, 19, 20, 21, 22.

Can you work out what numbers are written on the reverse side of each disc?

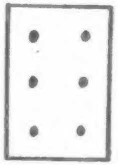
b) Investigate totals produced by discs numbered differently. Can you produce eight consecutive numbers as totals?

Investigate for 2 discs

Are there ways of numbering 3 discs so each combination gives a different total?

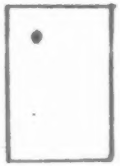
43. BRAILLE

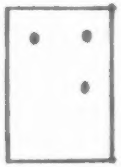
Louis Braille, a frenchman living in the 19th Century, invented an alphabet for use by blind people.

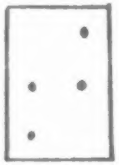


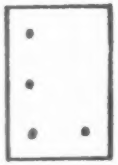
The alphabet consisted of raised dots in rectangular patterns. Each pattern of dots was based on a 3 x 2 rectangle.

Some patterns used are given below:


A


D


T

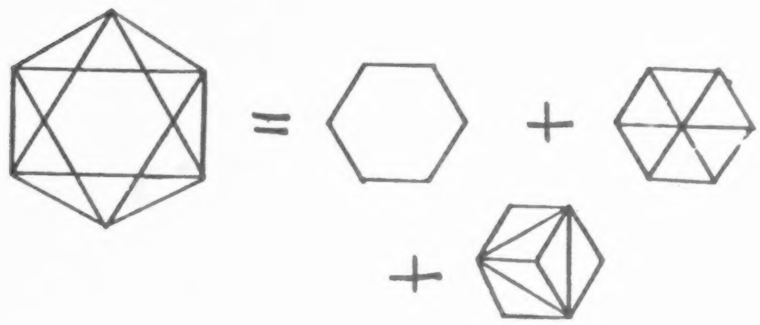

V

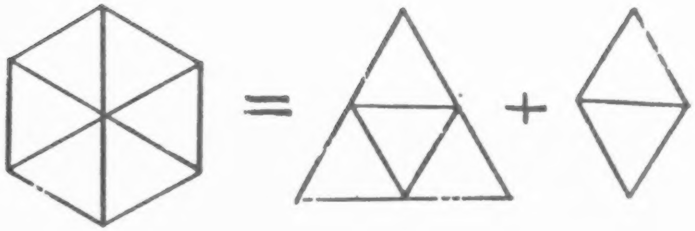
How many different patterns can be made using this system?

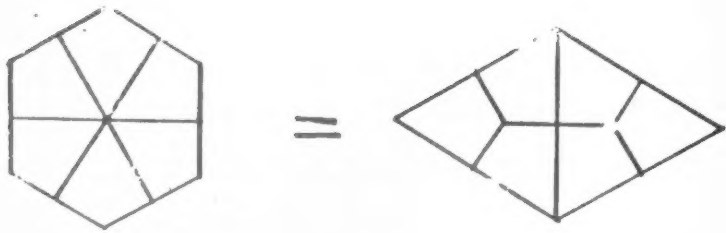
Investigate for different sized rectangles

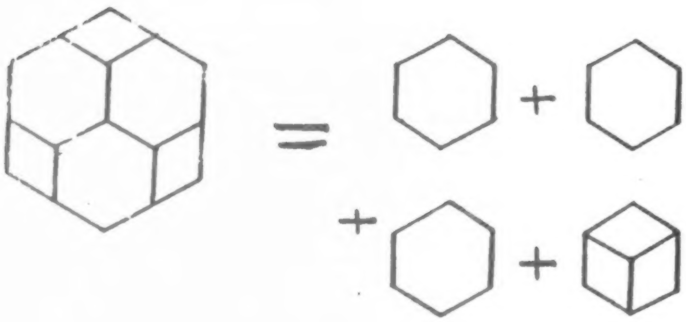
46. HEXA-PUZZLES

Here are four ways of cutting up a hexagon to make further hexagons, parallelograms, equilateral triangles etc.









Investigate ways of dissecting hexagons.

56. SETS of FIVE

Here is a set of five numbers

$$\{1, 2, 3, 7, 12\}$$

17 can be made by adding some of them together:

$$17 = 12 + 3 + 2$$

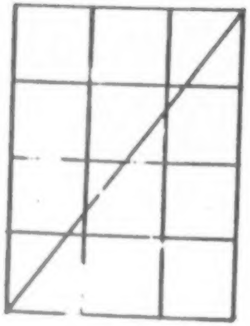
Can you make 11? 23? 25?
(You are allowed to use each number only once)
What is the highest number you can make?
Which numbers can't be made?

Invent other sets of five numbers - try to make a set which produces every number up to the highest.

Extension: Can you make a set of five numbers that will give every number from 1 to 20 but none above 20?

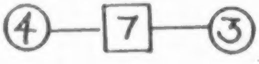
57. DIAGONALS

Investigate the number of squares cut by the diagonal of a rectangle.
(In this diagram it is six)

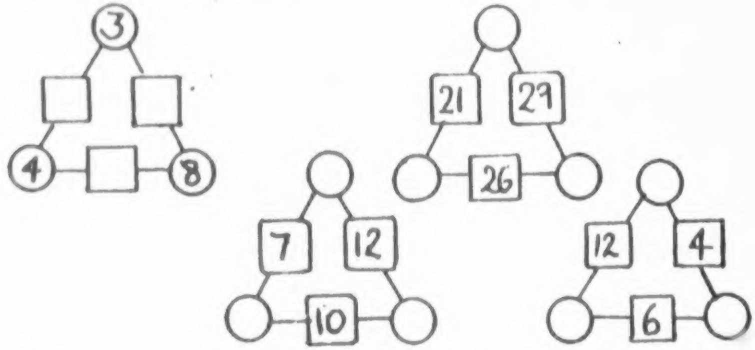


59. ARITHMOGONS

In an arithmogon, the number in a square must be the sum of the numbers on each side of it:

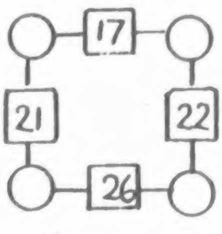


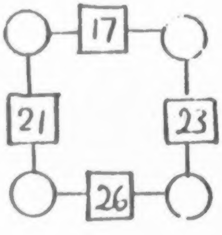
Solve these if possible


3
4
8
21
29
26
7
12
10
12
4
6

Find a way of solving these (apart from trial and error). Is there always an answer? Only one answer? When are fractions needed? When are negative numbers needed?

Try these





Pentagons? Hexagons?

2

Number patterns

A square array such as the one shown below offers many opportunities for the discovery of number patterns. In particular, consideration of the patterns of multiples can open an interesting field of enquiry. Many teachers will be able to draw from their own experience in the classroom and so extend or supplement what is discussed here. No attempt is made either to exhaust the situation, or to claim that the sequence of ideas presented has intrinsic merit. It is the underlying freedom of choice, permitting this or that sequence to emerge, which merits our attention.

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

Fig.1

Although we show here a particular square array of numbers (sometimes called the Pythagorean square), and investigate certain patterns within it, we need not keep strictly to this framework, for we may use our freedom to vary the number of elements in the columns and in the rows. If we allow the simple extension of varying the number of elements in each row, we generate, as we shall see, a wealth of possibilities which are mathematically relevant. We can often miss opportunities of extending mathematical activity by

sticking rigidly to a particular situation (the Pythagorean square, in this case) because we are not conscious of the fact that *we* have the power to make changes in the situation, to study the consequences of our actions, and that this is an integral part of mathematical thinking, even at an elementary level. To extend the columns of the array may produce little of interest. But the mere fact that we have recognized that this specific alteration does not affect the structure of the situation is in itself important.

Let us look more closely at the Pythagorean square: a natural starting-point since we normally work in base ten. Some properties are readily apparent and we can expect a variety of comments from children if we ask a question as 'open' as, 'What can you say about this?' Alternatively we can direct the enquiry by asking a series of questions:

How many numbers are there in each row?

Where are the numbers which have a 4 in the unit position?

Where are the numbers having a 4 in the tens position?

Where is the number which has a 4 in both positions?

What can be said about the numbers in the 7th row? in the 5th column?

Which number is in the 3rd row and the 2nd column?

If we extend the array beyond 100, in which column will you find 104, 638, 7625, 38276391762? How do you know?

Can you name any large number which will be in the 6th column? What do you take into account when you make your choice?

Can you think of any number which cannot be fitted into the array?

Look for the set of even numbers and put a ring round each one. What do you notice? Can you describe the 'pattern' of the even numbers? Do the odd numbers form a similar pattern?

What about the multiples of 3? Do they make a pattern? If so, can you describe it?

Let us pause for a moment and consider these two approaches to the situation. On the one hand, the teacher asks, 'What can you say about this?', and waits to hear the replies of the children. On the other, the teacher asks questions which direct the children's perceptions and subsequent thoughts along predetermined channels. This is, of course, far too simple a distinction to make, for in practice the two merge in varying degrees. Nevertheless, it is useful for discussion purposes, particularly as the tendency for one or the other type of approach to *dominate tells us something about attitudes towards the learning situation. By asking more open questions, we are allowing the children (at least, some of them – it is important to recognize this limitation) to talk about what the situation reveals to them personally.*

In this sample of questions an effort has been made to extend the awareness from the particular to the more general. Having focused attention on the relation between the rows and column positions, and the units and tens digits, we have taken a further step toward abstraction by considering the column positions of numbers greater than 100, and gone on to talk about numbers so big that it is inconceivable that any child should actually continue the array far enough to include them.

Multiples

The preliminary set of questions ended with a glance at the patterns formed by the sets of even and odd numbers and the multiples of 3. What can we say about the positions of the multiples of other numbers? Do they form patterns?

It will be convenient at this stage to introduce a notation for the sets of multiples; children will be able to invent other possibilities. Here we shall denote the set of multiples of 2 by M(2), the set of multiples of 6 by M(6), etc.

The multiples of 2 are to be found in alternate columns, and we can refer to this as a 'column pattern.' Are there other sets of multiples which generate column patterns? M(5)? M(10)? In each case, all the numbers in the columns are part of the total pattern. What about M(4)? This forms a column pattern in a way, although there is a difference in that every number in each column of the pattern is not within the set. We may even say that M(3) is a column pattern in this sense, but the eye more readily sees this as a 'diagonal' arrangement. In M(4) some columns are not a part of the pattern, whereas in M(3) elements are to be found in every column.

We can remove some of these ambiguities if we wish by restricting our use of words. A definition may satisfy our intuitive insight into a situation for a while, but as a result of further investigation and discussion with others, it seems inadequate in that it is too broad; it allows too much. We shall describe as 'column' patterns those in which every number in the columns belongs to the pattern. With this use of the word M(2), M(5) and M(10) are column patterns; M(4) is not.

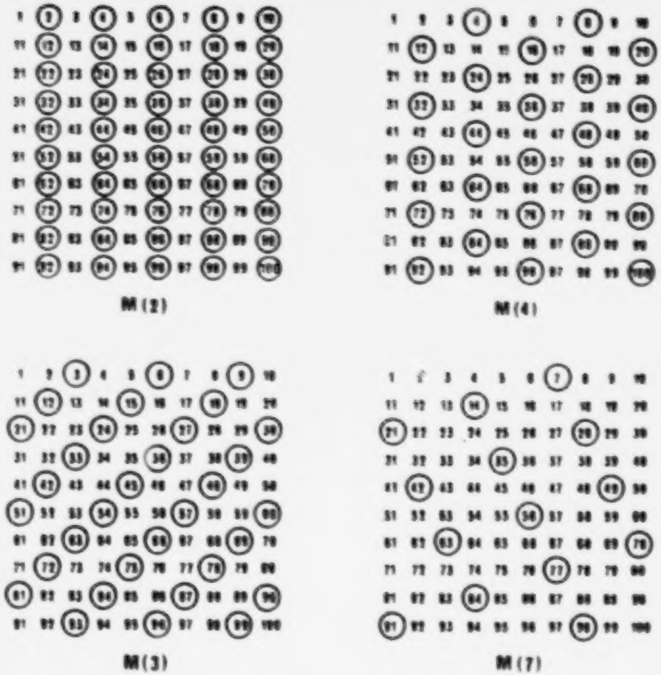

M(2) M(4) M(3) M(7)

Fig.2

Exercises

1. Why is it that M(2), M(5) and M(10) produce column patterns in this array?

2. Why does the 'diagonal' pattern for M(3) arise? Can it be described as a shift of 1 down and 1 to the left? (Or 1 down and 2 to the right?) Describe M(4) in this way. And M(5).

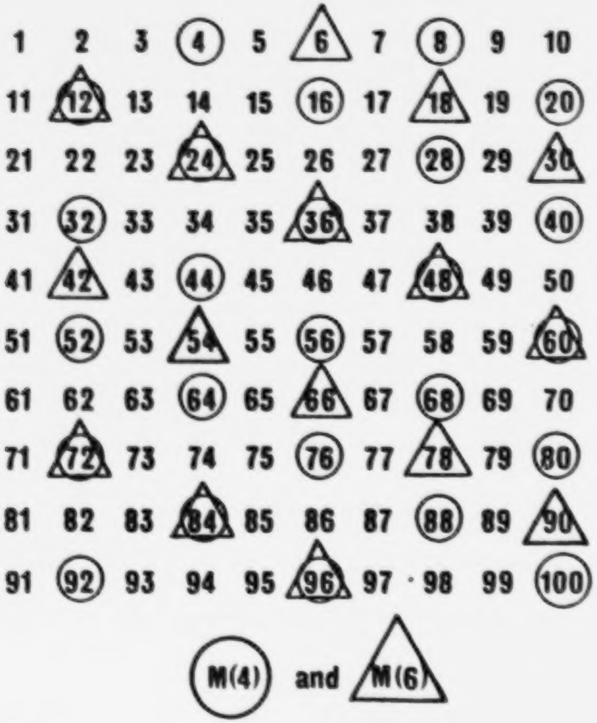
Can the variations in the horizontal shifts for these patterns be explained? Is it linked with the number of elements in each row?

3. Describe the patterns generated by M(6), M(7), M(8), M(9), M(11), etc.

4. Compare M(9) with M(11). Are they similar? Different? Compare M(7) and M(13).

5. Which of the patterns in question 3 spread over every column in the array? Can a reason for this be given? What about M(14) and M(21)?

Some patterns are completely contained in others: M(4) in M(2), M(8) in M(2) and M(4), M(6) in M(3) and M(2), etc. The numbers contained, for example, in both M(6) and M(4) are the common multiples of 4 and 6 (12, 24, 36, . . .), and these form a pattern of their own.



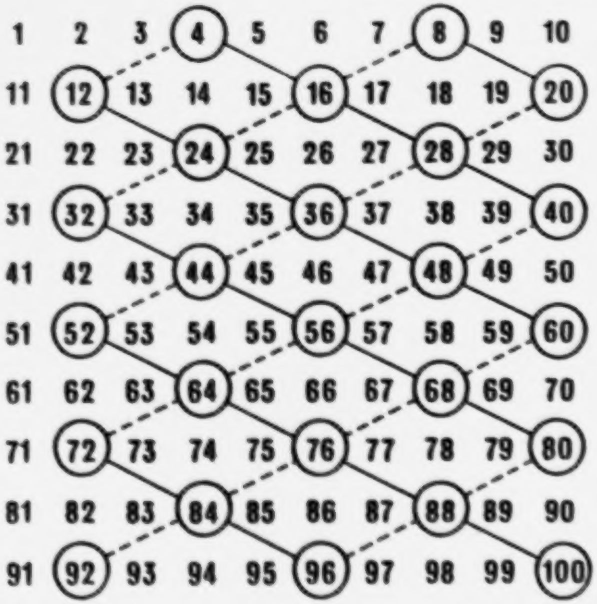
1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

Fig.3

A convenient device for exploring the patterns of common multiples of sets of numbers is the superposition of sheets of acetate (see the article 'Searching for Patterns' by M. Beberman in [14] for more detail on this). The pattern of M(3), say, can be shown by colouring on one sheet and the pattern for M(5) by a different colour on another. If these are put on top of each other, the intersection of the two sets of numbers can be seen where the two colourings coincide. In this case it will show the set of common multiples of 3 and 5, i.e. M(15).

This method can of course be extended to the common multiples of three or more numbers. In the example we have suggested, the two numbers are co-prime (they have no common factor other than 1). By superposing M(6) on M(3), say, we see that all the numbers in M(6) are also in M(3), so in this case the intersection is M(6).

In a 'diagonal' pattern, other diagonals can be observed. Look at the pattern of M(4) below.



1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

Fig.4

We may notice, for example, that along the unbroken diagonals the numbers increase by 12 each time; the sum of the digits increases by 3 each time. How far is this true? When does this relationship break down, and why? These are not properties of this pattern only. If we begin with any number in the array, move 1 square down and 2 squares to the right, and go on repeating this movement, we obtain sequences with comparable properties. Explore what happens when we make other horizontal and vertical displacements.

What do we find if we look at the broken lines?

Prime numbers

Still considering the Pythagorean square, suppose we cross out 1, and then all the multiples of 2 except 2 itself, all the multiples of 3 except 3 itself, and do the same for 5 and 7, we are left with all the prime numbers less than 100. We do not need to go beyond the multiples of 7. Why not? How far would we need to go if we extended the square and wanted to select all the prime numbers less than 256?

Look at the positions of the prime numbers in the square relative to the positions of M(6):

1	$\boxed{2}$	$\boxed{3}$	4	$\boxed{5}$	⑥	$\boxed{7}$	8	9	10
$\boxed{11}$	⑫	$\boxed{13}$	14	15	16	$\boxed{17}$	⑱	$\boxed{19}$	20
21	22	$\boxed{23}$	㉔	25	26	27	28	$\boxed{29}$	㉚
$\boxed{31}$	32	33	34	35	㊱	$\boxed{37}$	38	39	40
$\boxed{41}$	㊷	$\boxed{43}$	44	45	46	$\boxed{47}$	㊽	49	50
51	52	$\boxed{53}$	(54)	55	56	57	58	$\boxed{59}$	(60)
$\boxed{61}$	62	63	64	65	(66)	$\boxed{67}$	68	69	70
$\boxed{71}$	(72)	$\boxed{73}$	74	75	76	77	(78)	$\boxed{79}$	80
81	82	$\boxed{83}$	(84)	85	86	87	88	$\boxed{89}$	(90)
91	92	93	94	95	(96)	$\boxed{97}$	98	99	100

Fig.5

The prime numbers, with the exception of 2 and 3, either precede or follow a multiple of 6. Is this generally true?

Excluding 2, all prime numbers are odd; every odd number lies between two even numbers. In every set of three consecutive whole numbers, one and only one of them, is divisible by 3. (Why?) If we now consider any three consecutive whole numbers in which the middle one is prime, we know that this prime number is flanked by two even numbers, one of which must be divisible by 3. (The prime number cannot, by definition, be divided by 3 unless it is itself 3.) So this number is divisible by 2 and by 3, and therefore by 6. Hence any prime number (except 2 and 3) precedes or follows a multiple of 6.

The crossing-out method of selecting prime numbers is usually called Eratosthenes' Sieve. By crossing out 1 at the start we have assumed that 1 is not a prime number. As so often in dealing with number properties, we find that 1 is an odd man out. Does 1 satisfy the definition of a prime number or not? In fact we have a choice here since the definition is not clear at this point. Having made our choice, certain other consequences must follow if we are to be consistent. Mathematicians in general choose to regard 1 as neither prime nor composite.

Changing the rows

We recognized at the beginning of this chapter that we had freedom to change the number of elements in each row. Let us use this freedom and see what effect it has (see 'Searching for Patterns' [14]). As examples, we will consider two arrays, the first with seven and the second with six elements in each row.

1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31	32	33	34	35

etc.

(A)

1	2	3	4	5	6
7	8	9	10	11	12
13	14	15	16	17	18
19	20	21	22	23	24
25	26	27	28	29	30

etc.

(B)

Fig.6

In the Pythagorean square, we found certain basic types of visual pattern:

(i) column e.g. M(2), M(5), M(10),
(ii) diagonal, with numbers in all columns e.g. M(3), M(9), M(11),
(iii) diagonal, with numbers appearing only in certain columns e.g. M(4), M(6), M(8), M(12).

In (i) the generating numbers (2, 5, 10) were factors of 10, the number of elements in each row. In (ii) they were co-prime to 10. In (iii) they each had a factor which was also a factor of 10.

Can we find corresponding properties for the patterns of multiples in the arrays (A) and (B)?

1. Which sets of multiples now give column patterns?
2. Which give a pattern running through all columns?
3. Which patterns are limited to certain columns?
4. The multiples of 2 appear in 'chessboard' fashion in array (A). Is this true if there are 8, 9, 13 elements in a row? When is it true in general?
5. In array (B) the multiples of 3 appear in columns. What variation can we make in the number of elements in each row so that the multiples of 3 remain in columns? Is there more than one answer?
6. What will the number of elements in each row have to be for the multiples of 8 to appear in only two columns?
7. Can we make multiples of 7 behave like the multiples of 3 in the Pythagorean square? Is there more than one answer?
8. Make up more questions.

An addition game

Consider again one of the variants of the Pythagorean table – the one with seven elements in each row. This time we will label the columns for reference.

Choose any two columns. *C and F.* Choose a number in C and another in F. Yes, any number you like in these columns. Add them together. Which column contains your answer? *B.* And yours? and yours? Are all of them in B?

Let's try again. Choose two different columns. *E and A.* Where is the answer this time? *In F.* For all choices of numbers in E and A? *Yes.* Imagine the number array to be extended, still keeping seven numbers in each row. Now take two numbers in the extension, one in A and the other in B. Add them. Where is the answer? *In C.* Is it true that the answer is in C for all possible choices of numbers from columns A and B? *Yes.* Why? (See p.83 for some further discussion which may help in the search for a proof.)

How shall we write what we have discovered? $C+F=B$ *and* $E+A=F$. Is it true that $D+F=C$? that $A+B=C$? *Yes.*

What is the unknown in the statement $E+?=C$? *It can only be E. That is,* $E+E=C$. *But can we do this? You said 'Choose any two columns', and here we have a case where both of the added numbers come from the same column.* Well, shall we allow ourselves to do this? If we want to be able to add together *any* two numbers our rules must cover the possibility of adding two numbers from the same column. Let us agree, then, that we can take the two numbers from any columns, and that we permit the special case of taking the same column twice.

A	B	C	D	E	F	G
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31	32	33	34	35
36	37	38	39	40	41	42
			etc.			

Fig.7

What are the answers to A+A, B+B? Does D+D=A? *One of them seems very peculiar:* $G+G=G$.

Let us look carefully at column G. Choose another column. *B.* Add any number in G to any number in B. Where is the answer? *Still in B.* Try again: add any number in G to any number in E. *The answer is in E.* So we have $B+G=B$ and $E+G=E$. Is $C+G=C$? *Yes.* We also know that $G+G=G$. What happens, then, if we add a number in G to any other number? *The answer stays in the same column as the second number.*

Will the same kind of adding game work with the Pythagorean square? Which column behaves like G in this case? Why does it work like this? *In the Pythagorean square, it looks as if the property depends only on the units digits of the numbers chosen.* What is the generalization for other arrays? The units digit is the remainder on dividing the number by 10. What is the analogue when there are seven elements in each row? Is it a property of the remainders on division by 7? (see p.83, note 3).

Suppose now that we keep the rules of the game the same, but replace the operation of addition by multiplication. Explore the development of this game.

Exercises

1. There are many other kinds of number array. Investigate the following and try to find some properties, however trivial they may seem to be.

(a)	0	1	2	3	4	5	6	7	8	9	10
	1	2	3	4	5	6	7	8	9	10	11
	2	3	4	5	6	7	8	9	10	11	12
	3	4	5	6	7	8	9	10	11	12	13
	4	5	6	7	8	9	10	11	12	13	14
	5	6	7	8	9	10	11	12	13	14	15
	6	7	8	9	10	11	12	13	14	15	16
	7	8	9	10	11	12	13	14	15	16	17
	8	9	10	11	12	13	14	15	16	17	18
	9	10	11	12	13	14	15	16	17	18	19
	10	11	12	13	14	15	16	17	18	19	20

(b)	0	1	2	3	4	5	6	7	8	9
	1	2	3	4	5	6	7	8	9	0
	2	3	4	5	6	7	8	9	0	1
	3	4	5	6	7	8	9	0	1	2
	4	5	6	7	8	9	0	1	2	3
	5	6	7	8	9	0	1	2	3	4
	6	7	8	9	0	1	2	3	4	5
	7	8	9	0	1	2	3	4	5	6
	8	9	0	1	2	3	4	5	6	7
	9	0	1	2	3	4	5	6	7	8

2. Decide how to continue the following parts of arrays, and try to find some properties.

(a)	1	1	1	1	1	1	1	1	1	1	.	.
	1	2	3	4	5	6	7	8	9	10	.	.
	1	3	6	10	15	21	28	36	45	55	.	.
	1	4	10	20	35	56	84	120	165	220	.	.
	.	.	.	.	.	.	.	.	.	.	.	.
	.	.	.	.	.	.	.	.	.	.	.	.

(b)

1

1 1

1 2 1

1 3 3 1

1 4 6 4 1

1 5 10 10 5 1

. . . .

. . . .

(c)	1	1	1	1	1	1	1	.	.	.
	2	4	8	6	2	4	8	.	.	.
	3	9	7	1	3	9	7	.	.	.
	4	6	4	6	4	6	4	.	.	.
	5	5	5	5	5	5	5	.	.	.
	6	6	6	6	6	6	6	.	.	.
	7	9	3	1	7	9	3	.	.	.
	8	4	2	6	8	4	2	.	.	.
	9	1	9	1	9	1	9	.	.	.

Can you hazard any guesses about the origin of array (c)? The examples on p.283 may offer a clue.

3. (A number pattern of a different kind.)

$1\times 1=1$

$11\times 11=121$

What are the values of the products 111×111 and $1{,}111\times 1{,}111$? What are our expectations about the value of $1{,}111{,}111\times 1{,}111{,}111$? What causes the pattern of digits in the products? What happens after the result 12,345,678,987,654,321 is reached? What will be the next result?

These answers all have an odd number of digits, and the largest digit is in a certain position. Is it possible to obtain the answer 1,221 or 123,321 or 12,344,321 as the results of similar multiplications?

What numbers *can* be multiplied together to give 123,321?

What is the product $111{,}111\times 11{,}111$?

How far are the results of the explorations you have made dependent on the numbers being expressed in the scale of ten (i.e. in base ten)?

Paper folding

It is interesting to attempt to evolve some patterned activity *in which the mind is not concerned directly with numbers in the first instance, but rather with some repetitive action out of which number patterns can arise. As illustrations of this idea, we shall consider a few examples. Paper folding provides us with a simple and convenient starting point.*

Take a rectangular sheet of paper and fold it once to make a four-page booklet. Number the pages 1 to 4. Open the sheet and notice that the sum of the numbers on either side of the sheet is 5.

Now take two sheets of paper, fold each as before and insert one inside the other to make an eight-page booklet. (If 15 sheets are used how many pages will the booklet have? How is the number of pages related to the number of sheets?) Number the pages, detach the sheets and open them out. What do you find? Each pair of numbers sums to 9.

Imagine a booklet made from six sheets. What will be the number on the last page? Is it true that each pair of numbers on one side of a sheet sums to 25 this time? Can you find 1 and 24, 2 and 23, 3 and 22 etc.?

What is the relationship between the sums of the pairs of the numbers and the number of pages in the booklet? In the booklet made from six sheets, which numbers face each other in the centre?

24

WEEKLY CHALLENGE

Use four 4s to make all the numbers from 0 to 50.

Example: $6 = 4 + \frac{4+4}{4}$

You may use any mathematical signs but only four 4s may be used for each number.

$$+ \quad - \quad \times \quad \div$$

$$\sqrt{} \quad ! \quad (\ )$$

Can you make 33, 39, or 41?

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MONDAY

Use the numbers 0–9 so that the rows, columns, and 2 main diagonals have the sum of 21.

		5	
	8		6
	5		7
		8	

A certain word has nine letters. If you take away six letters only one will be left. What is the word?

TUESDAY

Find more than 10 ways to make 25¢ with coins.

What difference would there be in the weight of a perfectly air-tight cage if a 750 gram bird sat on the perch or flew about?

WEDNESDAY

A leak in the roof allows 2 drops through the first day, 4 drops through the second day, 8 drops the third, etc. When will the 500th drop fall through?

Why is twice 10 like 2 times 11?

THURSDAY

Lloyd gave $\frac{1}{2}$ his marbles to Lee. Then he gave $\frac{2}{3}$ of the remaining ones to Lynn. If he ended up with 10 marbles, how many did he have when he started?

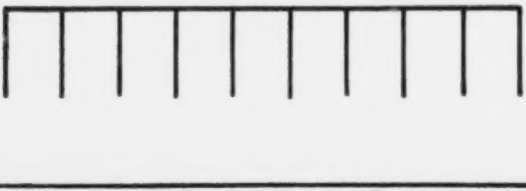
What goes up and never comes down?

FRIDAY

Replace **X**, **Y**, and **Z** with numerals to make a true equation.

$$\begin{array}{r} XX \\ +\ XX \\ \hline YYZ \end{array}$$

Without using more than one per stall, get ten horses in these nine stalls.



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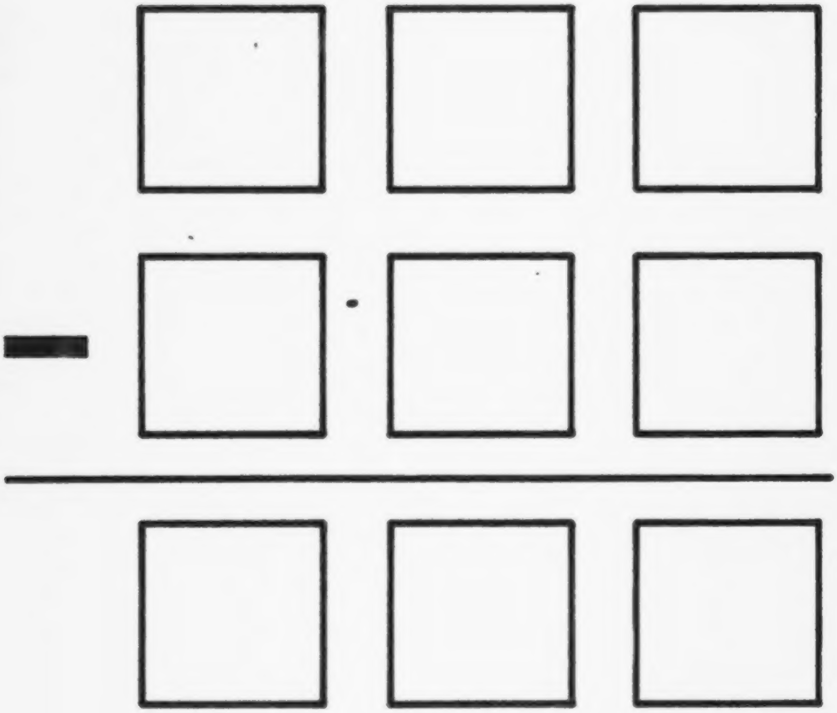
WEEKLY CHALLENGE

Use tiles 1 to 9 to make a true subtraction problem.



How many different solutions can you find?

There are more than 175 different answers.

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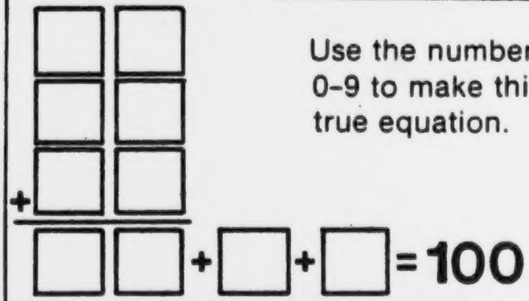
MONDAY



Use the numbers 0-9 to make this a true equation.

I have a window a yard square and it lets in too much light. How can I block up one-half of it, and still have a square window a yard high and a yard wide?

TUESDAY

I have 19 coins that total $1.00. I have exactly twice as many pennies as dimes. What coins do I have?

A bottle and a cork together cost $1.10 The bottle costs $1.00 more than the cork. How much does each cost?

WEDNESDAY

Replace **A, B,** and **C** with numbers so that:

$$A \times A = B$$
$$B - A = C$$
$$A + A = C$$

Why is a horse half-way through a gate like a cent?

THURSDAY

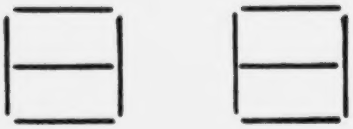
A square field with a fence around it contains sixteen square acres. It is divided into square acre plots. How many of those acre plots will be fenced on two sides? How many will be fenced on one side? on no sides?

What is the difference between dimes minted in 1976 and those minted in 1980?

FRIDAY

Use the same digit eight times to get 1000. Any digit from 1-9 may be used, but you must use that same digit eight times.

Move three toothpicks to another position so you will have five.



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WEEKLY CHALLENGE

Wow! A Millionaire!

Spend a million dollars.

Use newspaper ads, catalogs, etc. to find items to buy.

Round prices off to the nearest dollar.

Keep a running subtraction of your purchases until you go broke.

How many items did you buy?

(You may not give money away or buy more than two of the same item.)

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MONDAY

Use numbers 0-9 to make a true equation.

$$(\square \times \square) \times (\square + \square) \times (\square + \square) \times (\square + \square) \times \square + \square = 80{,}000$$

Four boys washed a car for 50¢. They didn't know how to divide the money equally, so the car owner said, "I will give the four of you $\frac{4}{5}$ of the total amount. And to the first one to tell me how much it is, I will give $\frac{1}{2}$ of the other $\frac{1}{5}$." What did the smart boy earn?

TUESDAY

Make a dollar with 34 coins, none of which is a half-dollar.

What word in math names a dessert?

WEDNESDAY

Replace the letters **A, B,** and **C** with numbers so that

$$\begin{array}{r} A\,B\,C \\ +\,A\,C\,B \\ \hline C\,B\,A \end{array}$$

Would it be better to have a truckload of nickels or half a truckload of dimes?

THURSDAY

Addition problems once in a while seem to "turn around" answers in multiplication.

Example: 9 + 9 = 18 9 × 9 = 81

Find a problem in this format, where the answer in multiplication is just "turned around" from the answer in addition.

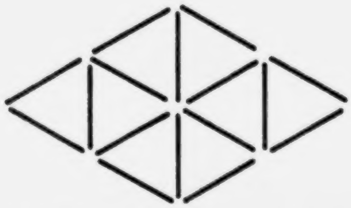
$$\begin{array}{r} \square\square \\ +\ \square \\ \hline \square\square \end{array} \qquad \begin{array}{r} \square\square \\ \times\ \square \\ \hline \square\square \end{array}$$

Four average-sized cigarette butts will roll into one whole cigarette. If you had sixteen cigarette butts, how many full-sized cigarettes could be made?

FRIDAY

A donkey and a horse were carrying bales of hay. If the horse gave the donkey one bale, they would have the same amount. If the donkey gave the horse one of his bales, the horse would have twice as many as the donkey. How many bales was each carrying?

Remove 9 toothpicks to get 2 triangles.



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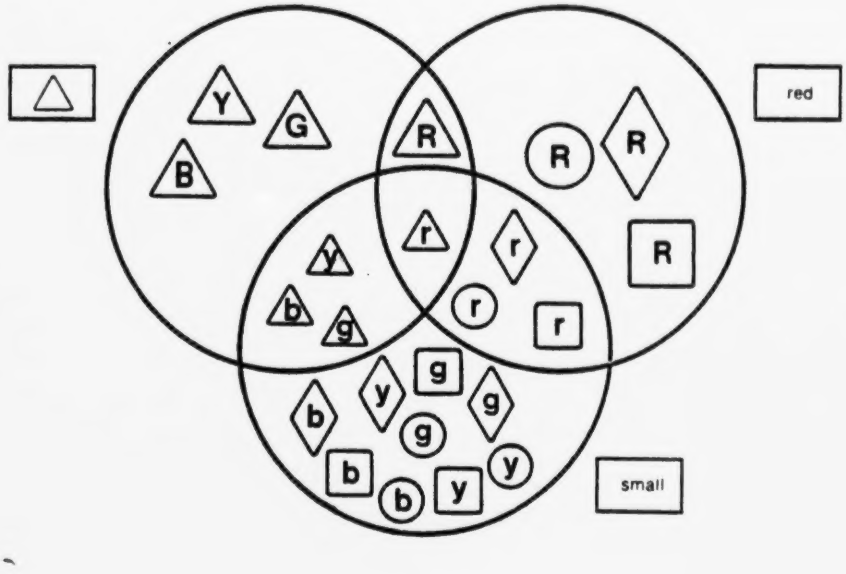
BE A DETECTIVE

After Jane finished working on this three-loop problem her loops looked like this.


red
Y
G
B
R
R
R
R
r
y
b
g
r
r
r
b
y
g
g
g
b
b
y
y
small

Answer the questions about Jane's work on page 56.

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DETECTIVE QUESTIONS

Use Jane's Three-Loop Activity Page to answer these questions.
Use drawings to record your answers.

1. Where are the blocks that are both red and small? Name them.

2. Where are the blocks that are red and small and triangle? Name them.

3. How many blocks are small? __________
4. How many blocks are in the red, but not △ nor small? __________
5. How many blocks are red or triangle or small? __________
6. How many blocks are triangle or small? __________
7. How many blocks are in the triangle loop? __________
8. What blocks are small and triangle but not red?

9. What blocks are not triangle or red?

10. What blocks are small and red but not triangle?

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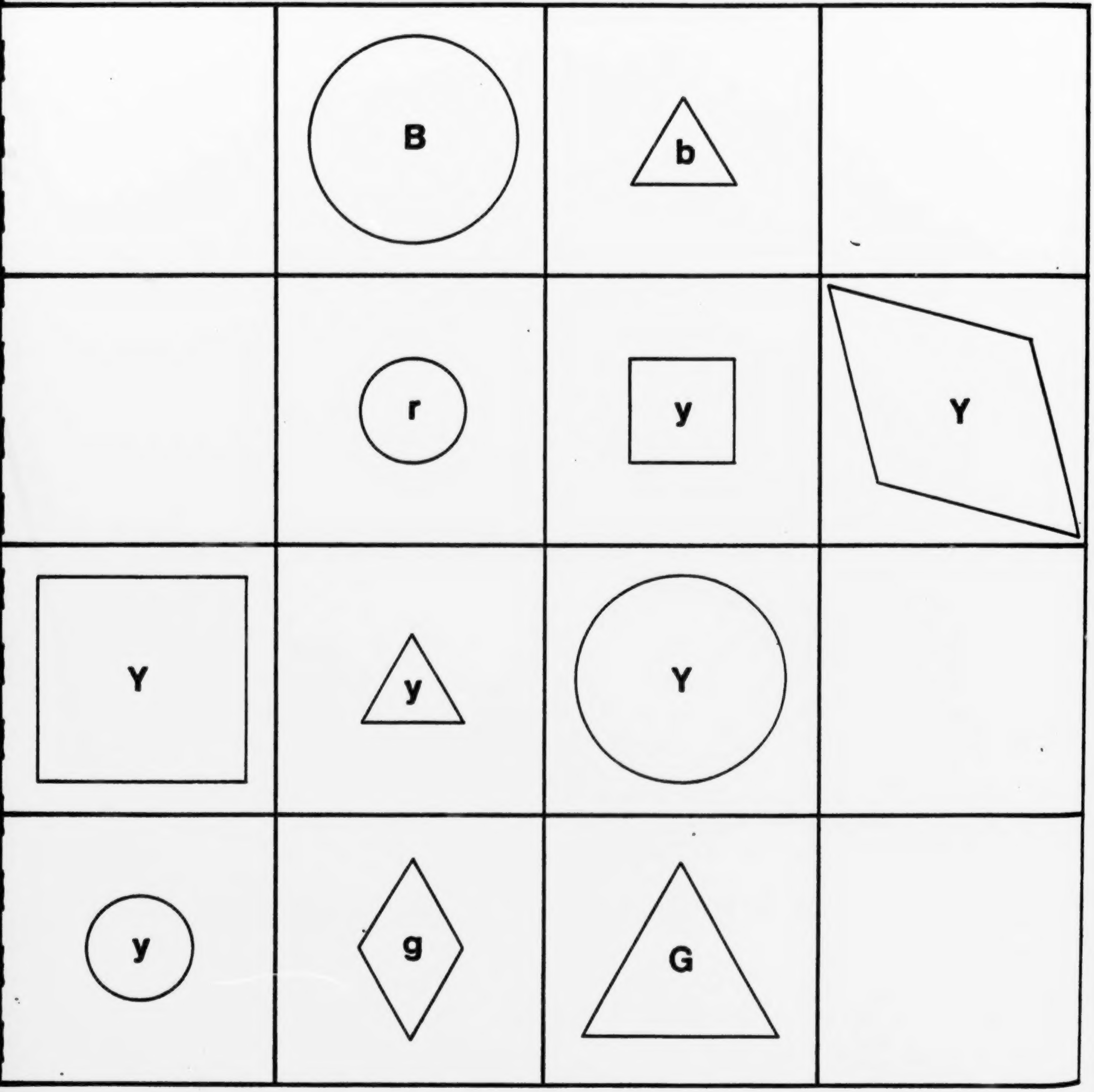
WHAT IS MISSING IN THE SQUARE?

This is a two-difference square. Use all your blocks and find the missing pieces.



Do this again using only your large blocks. Can you complete the two-difference square using only large blocks? If so, is there more than one way to do it?

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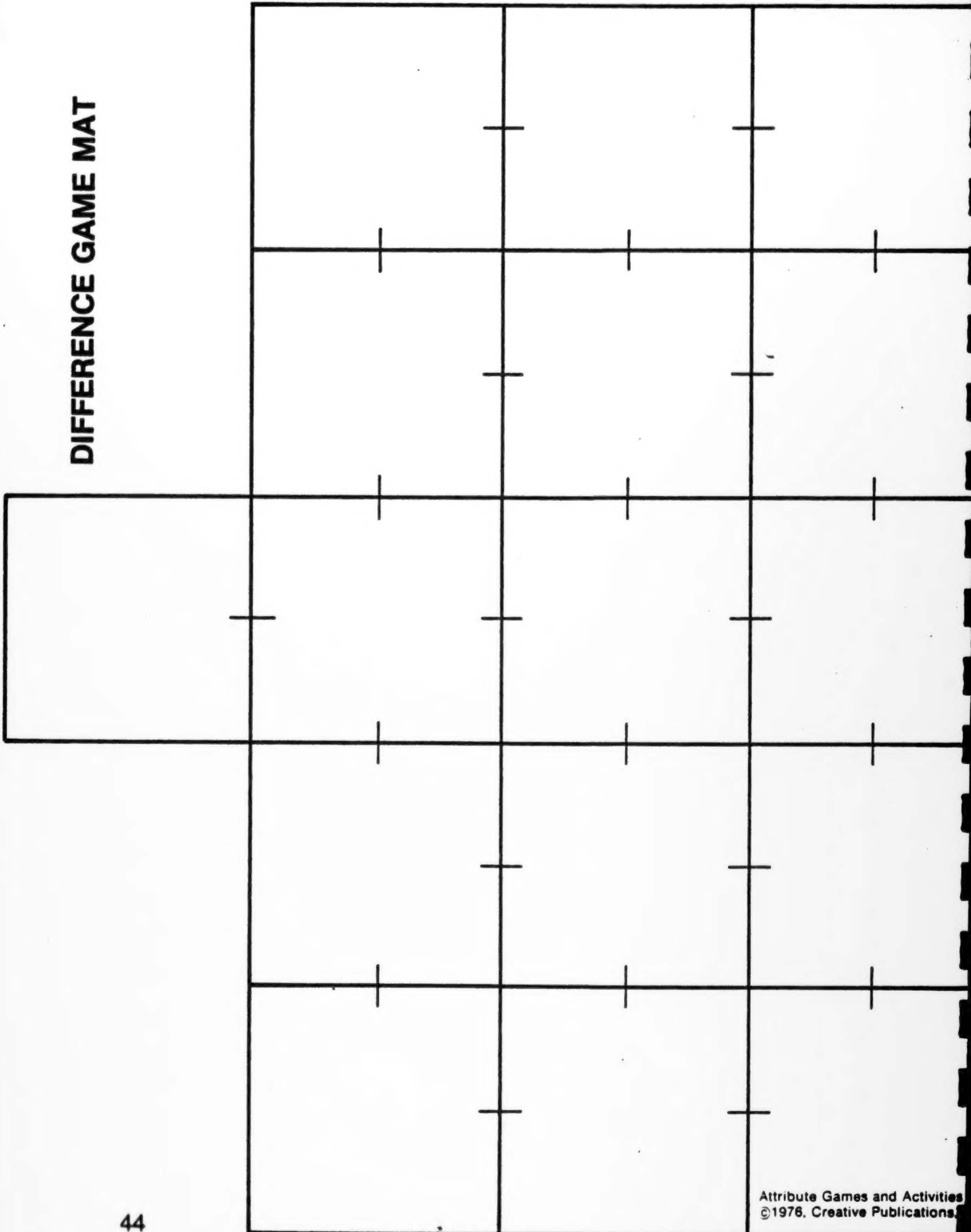
DIFFERENCE GAME MAT



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DIFFERENCE GAME

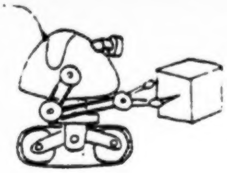
Materials: Attribute Blocks
Difference Game Mat (next page)

Procedure: This is a game for two players or two teams. The blocks are randomly divided between the two players, so each has 16 blocks. A turn consists of placing a block on the game mat.

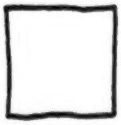
THE ONLY RULE is that a block must differ from its horizontal and vertical neighbors in exactly two ways. The first player who cannot place a block loses.

Further Teaching Suggestions: The "only rule" can be varied to one or three differences to make the game simpler or more difficult.

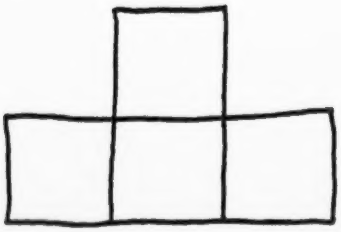
Use any of the Arranging Mats. Play with only small or large blocks to vary the game.



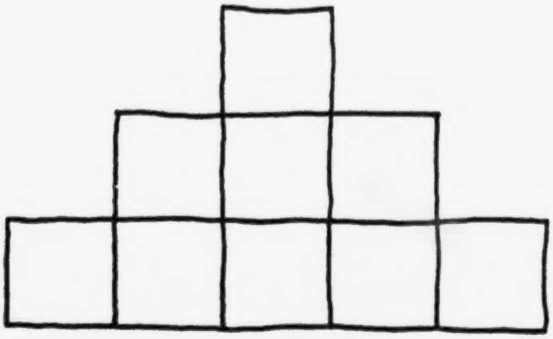
Cubes 11
Stairs



The 1st stair takes
1 cube to build.



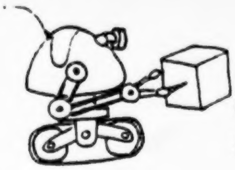
The 2nd stair takes
4 cubes to build.



The 3rd stair takes
9 cubes to build.

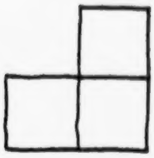
How many cubes to build the 6th stair?

Stair	Cubes
1st	1
2nd	4
3rd	9

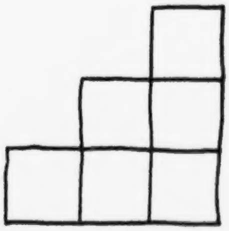


Cubes 12
Staircase

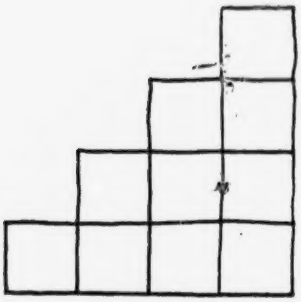
For 1 step,
use 1 cube.



For 2 steps,
use 3 cubes.



For 3 steps,
use 6 cubes.

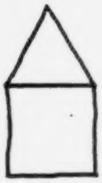


For 4 steps,
use 10 cubes.

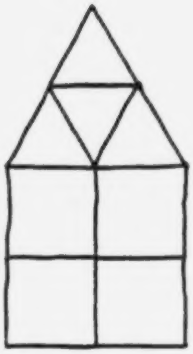
How many cubes for 10 steps?

Steps	Cubes
1	1
2	3
3	6
4	10

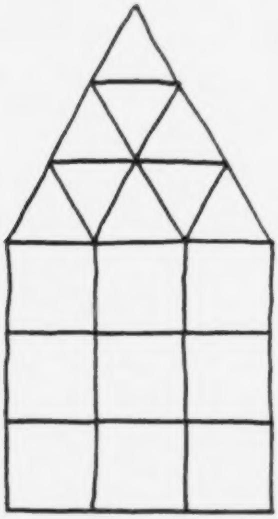
Pattern Blocks 12
Houses



The roof of the 1st house
takes 1 block to build.



The roof of the 2nd house
takes 4 blocks to build.



The roof of the 3rd house
takes 9 blocks to build.

How many blocks to build the roof of the 5th house?

House	Blocks in Roof
1st	1
2nd	4
3rd	9

CUISENAIRE® RODDLES

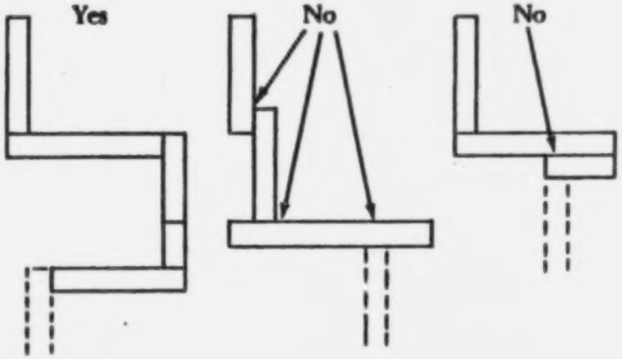
The Rods: The number of rods used for each puzzle depends upon the riddle at the bottom of each board. The correct set of rods is printed under each puzzle in the answer section.

The Challenge: For each puzzle, players make the correct path from Start (S) to Finish (F) using the rods identified in the riddle.

Underlying Mathematics: Counting, Addition and subtraction, Number sequences, Odd and even numbers, Fractions, Spatial perception

Pre-Game Activities: Before trying these puzzles, players need to know and understand the correct way to form continuous paths. Follow these steps:

Step 1 — Solve the rod riddle to determine the set of rods used in the puzzle
Step 2 — Place the first rod on Start (S), and make a continuous path finishing on the letter (F), using all the rods
Step 3 — Check to be sure rods never cross over black squares
Step 4 — Rods may only touch once, at either end. Examples:



As a readiness activity, pick any one of the puzzles.

Choose any five Cuisenaire rods, and make a continuous path from Start (S) to Finish (F).

Extend this activity by increasing the number of rods beyond five, again without reference to the colors mentioned in the riddle.

Once familiar with making continuous paths, find the correct path with the rods identified by the riddle.

The eight mazes are in order from easy to more difficult.

The answer section shows one path for each puzzle. Players may find the same path, but with changes in the position of some rods for Roddle #7. These paths are color variations - not different paths. Players finding different paths to any of the Roddles should write Cuisenaire Company of America to see if their solution qualifies for an Honors Award in Thinking Skills.

Post-Game Thinking Skills:

1) How do rod sizes affect their placement on the board? ____________________

2) How do the number of rods affect their placement on the board? ____________________

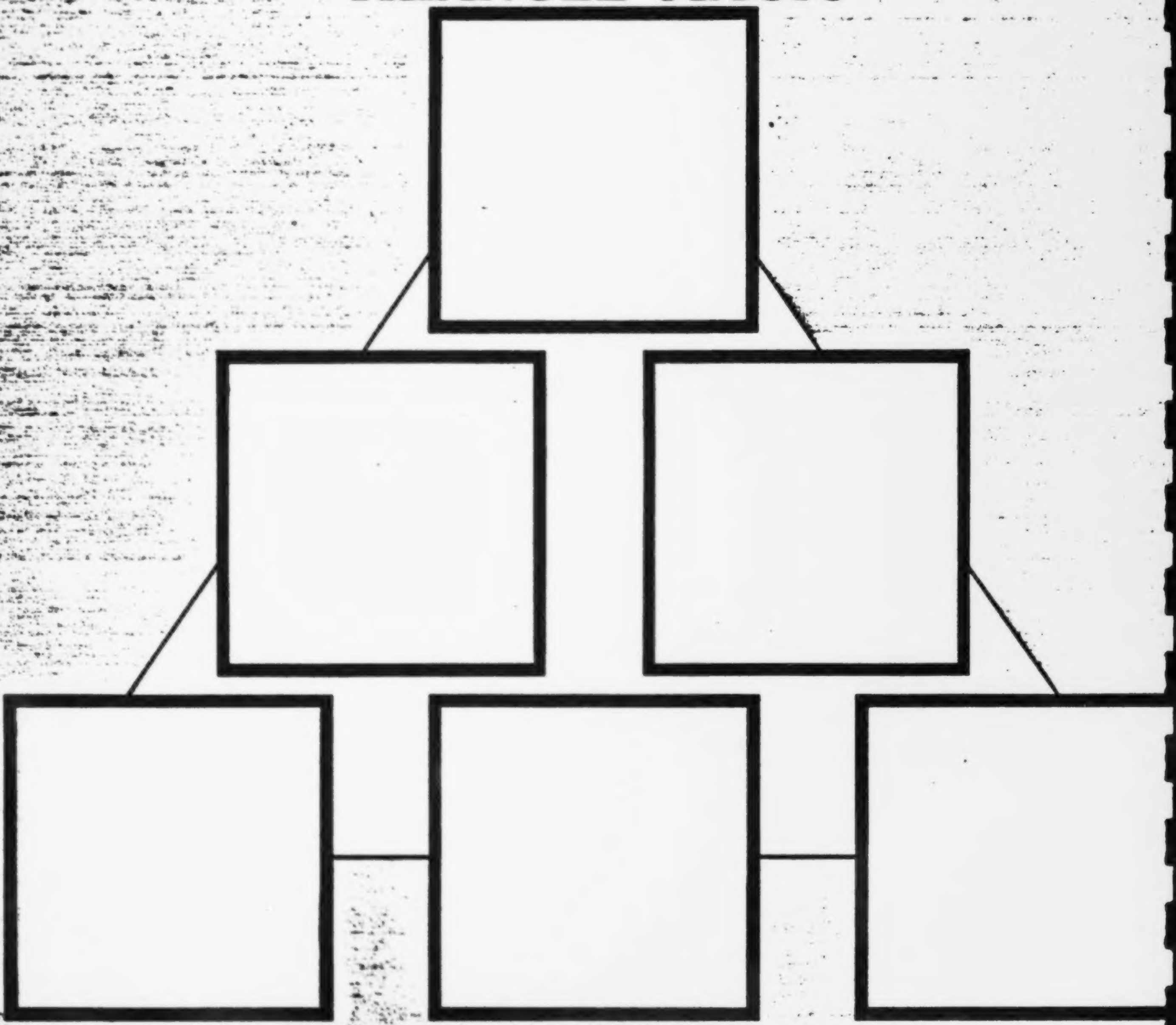
3) What effect do the black squares have on making continuous paths? ____________________

Definitions:

Number sequences — A set of numbers in a certain order. For example: 1, 2, 3, 2, 1, 2, 3, 2, 1, . . . is a repeating sequence.

Spatial perception — The ability to apply the senses to the solution of problems involving size and shape.

TRIANGLE MAGIC



The Rods: One each - white, red, light green, purple, yellow, dark green, and one orange measuring rod.

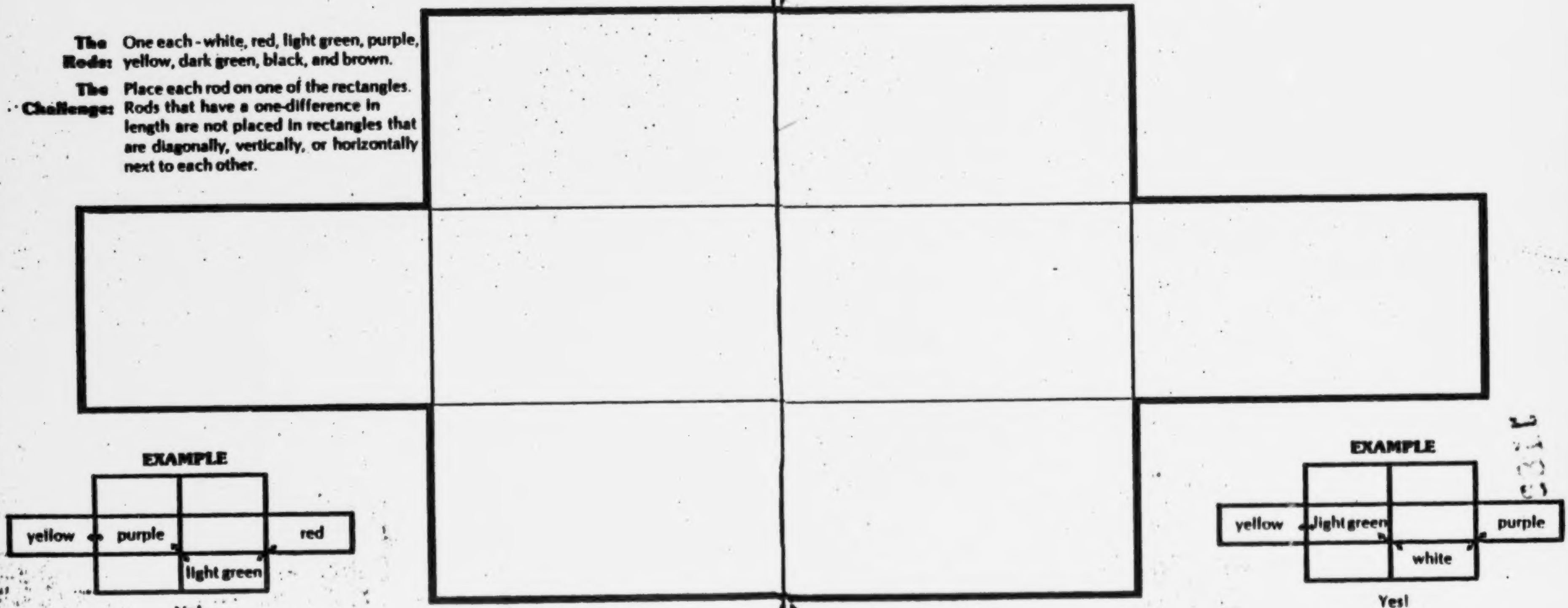
The Challenge: Place each rod on one of the squares. The three rods on each side of the triangle are just as long as an orange rod.

Cuisenaire® Roddles T.M. ©1981 Cuisenaire Company of America, Inc.

FACE OFF

The Rods: One each - white, red, light green, purple, yellow, dark green, black, and brown.

The Challenge: Place each rod on one of the rectangles. Rods that have a one-difference in length are not placed in rectangles that are diagonally, vertically, or horizontally next to each other.



EXAMPLE

yellow
purple
red
light green

No!

EXAMPLE

yellow
light green
purple
white

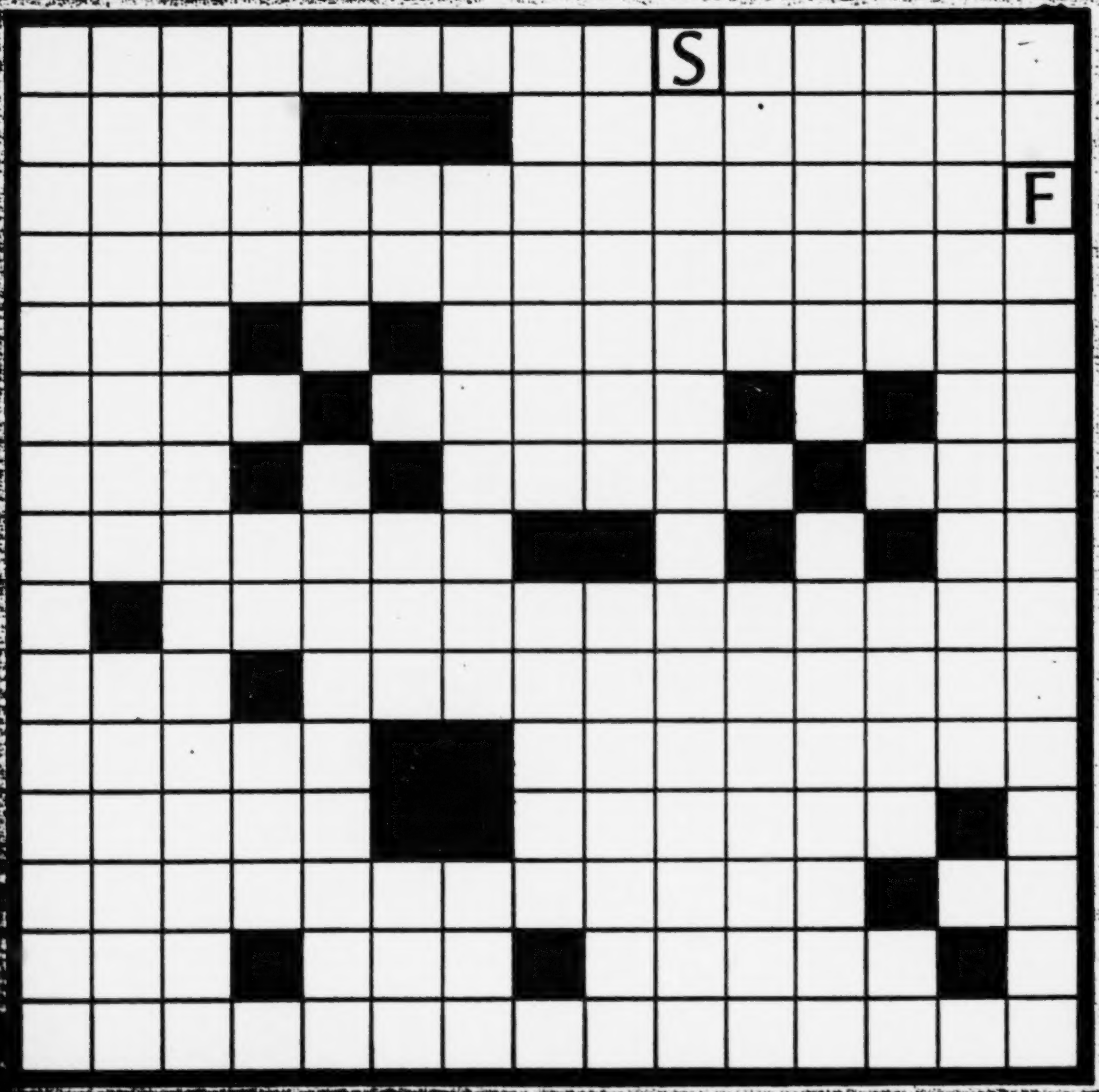
Yes!

isenaire ® Roddles™ ©1981 Cuisenaire Company of America, Inc.

1183

1184

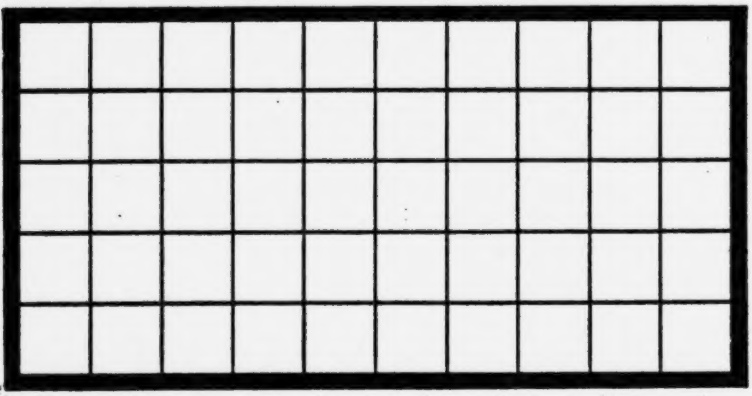
TOO MUCH!



[illegible] and the largest yet
[illegible]
[illegible]
[illegible] too much!

Roddie

FORCE OUT



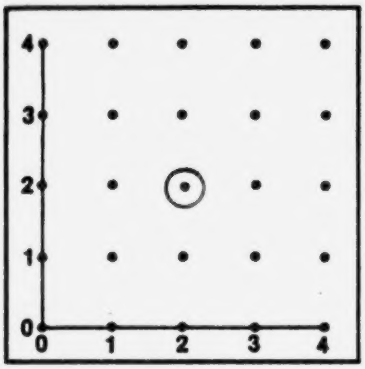
The Rods: Any rods from the 74-piece set.

The Challenge: Taking turns, two players cover the design by placing rods anywhere on the board. The winner forces a player to put the last rod down to cover the board.

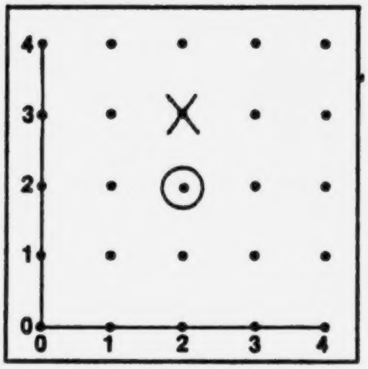
uisenaire® Roddles$^{T.M.}$ ©1981 Cuisenaire Company of America, Inc.

Tic Tac Toe Using Ordered Pairs of Whole Numbers

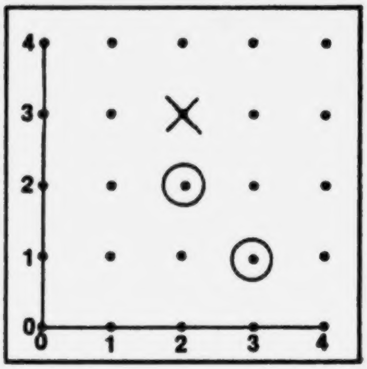
Many games involve the use of numbers and a grid. Shown below is a move-by-move account of a game that is similar to Tic Tac Toe. Study the moves to see if you can figure out how to play.


4
3
2
1
0
0
1
2
3
4

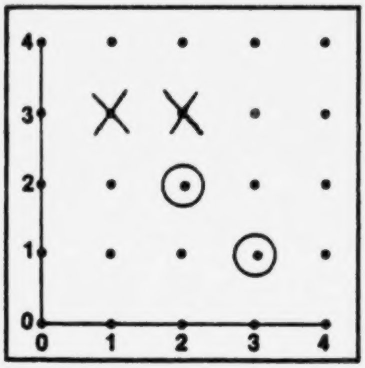
Chuck's
first move: (2,2)


4
3
2
1
0
0
1
2
3
4

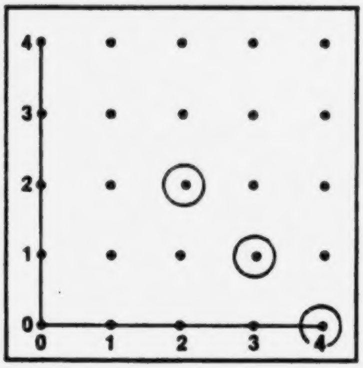
Mary's
first move: (2,3)


4
3
2
1
0
0
1
2
3
4

Chuck's
second move: (3,1)


4
3
2
1
0
0
1
2
3
4

Mary's
second move: (1,3)


4
3
2
1
0
0
1
2
3
4

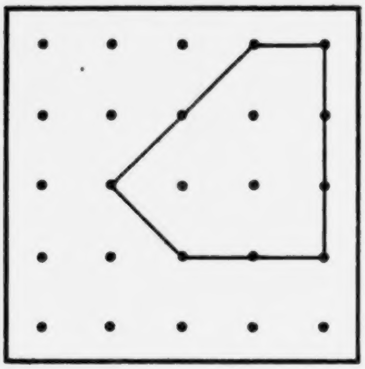
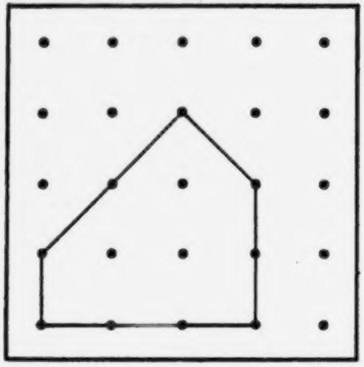
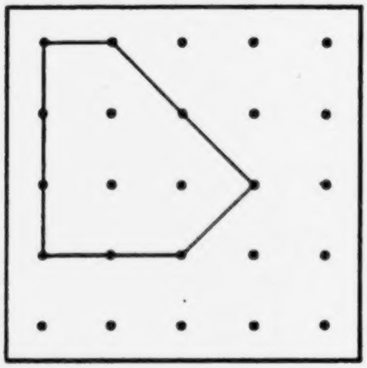
Chuck's
third move, (4,0) and he wins already!

3 in a row, column, or diagonal wins.

Play at least three games of Tic Tac Toe using the grids on the next page.

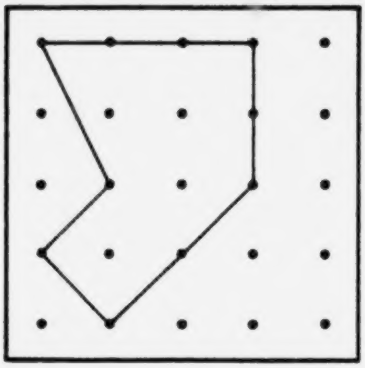
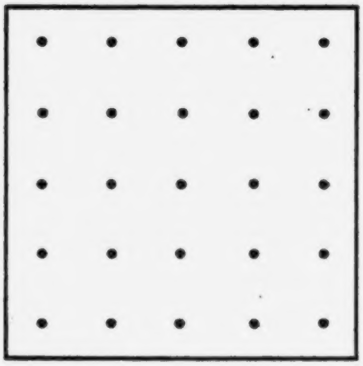
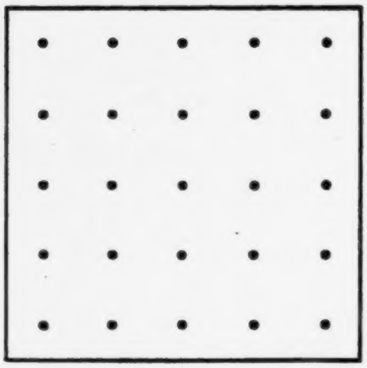
Congruent Polygons

Polygons that are the same size and shape are congruent. They do not need to have the same position or orientation. Here are three congruent pentagons. If you wish, cut them out to check that they match.

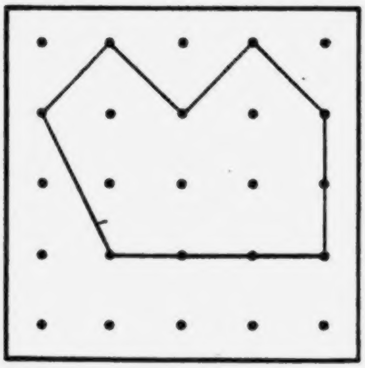
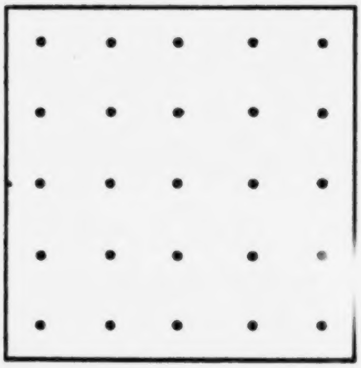
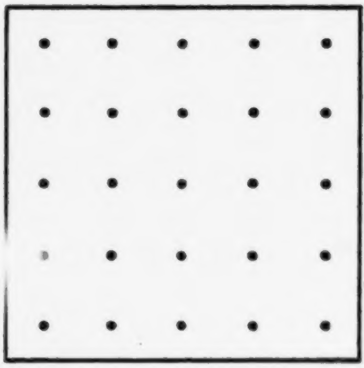




For each of the given figures, sketch two figures congruent to it on the grids provided.

1.

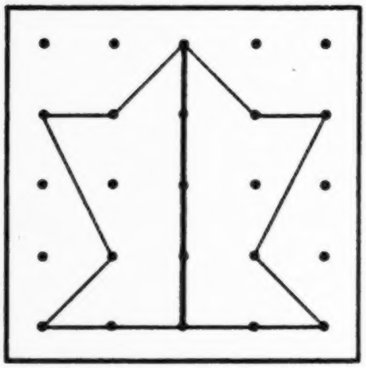
2.

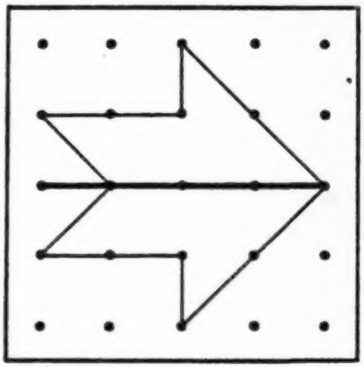




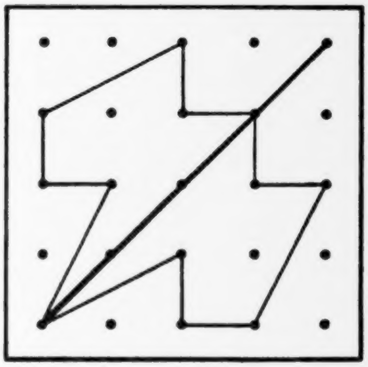
1188

Symmetry

A figure has a line of symmetry if it can be folded so that the two parts are congruent. Examples of three figures with line symmetry are shown below.

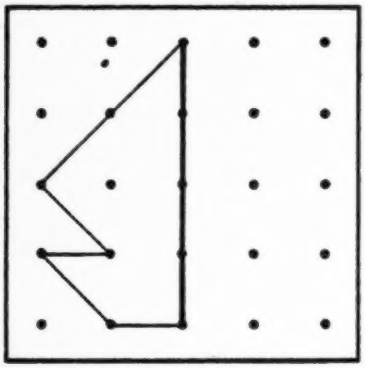




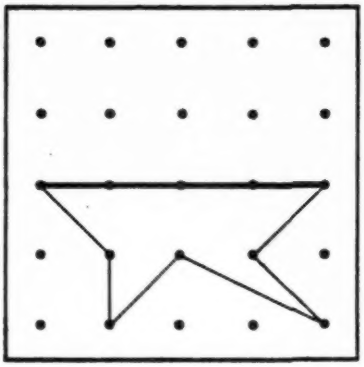


Complete each figure below so that the given line is a line of symmetry.

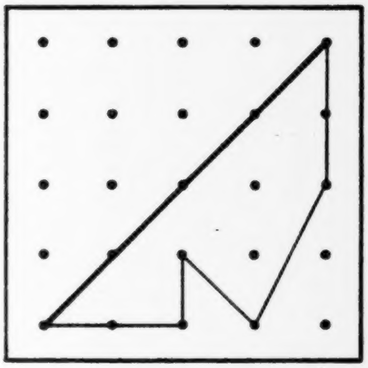
1.



2.

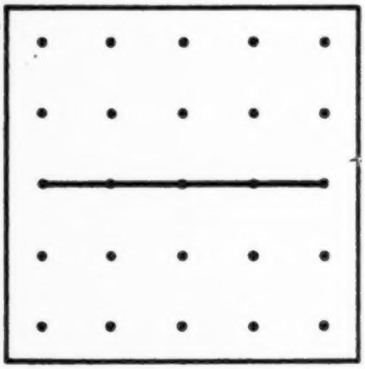


3.

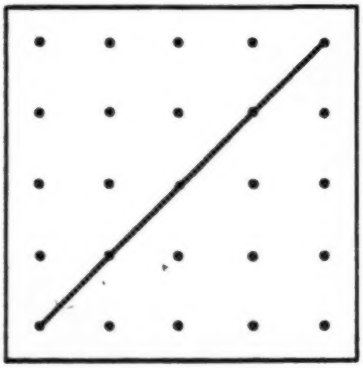


Draw both parts for these figures so that the given line is a line of symmetry. Compare your answers with your classmates.

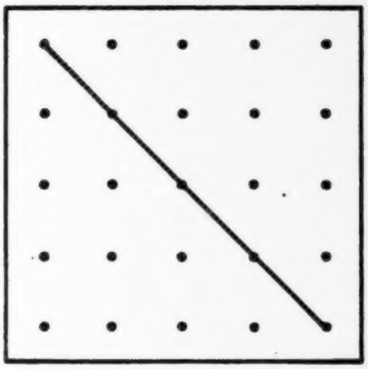
4.



5.



6.



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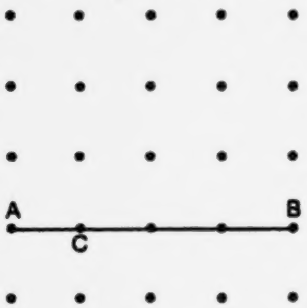
Multiplication of Fractions

Read through this discussion and then complete the exercises which follow.

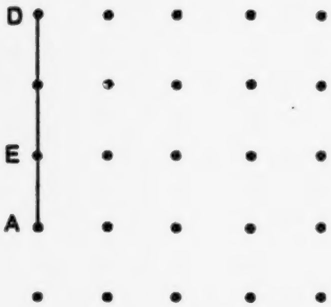
Problem: What is $\frac{1}{4} \times \frac{1}{3} =$ ____________

Step 1. Suppose AB = 1



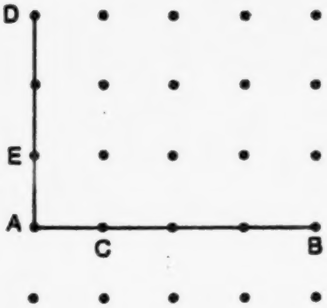
Then how much is AC? ______

Step 2. Suppose DA = 1

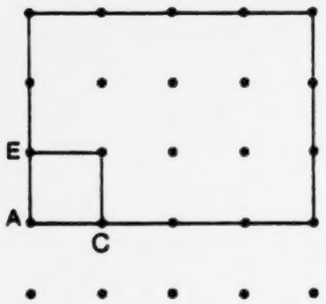


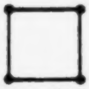
Then how much is EA? _______

Step 3. Complete a rectangle using DA and AB as two of the sides.



Step 4. Build a small rectangle using EA and AC as sides inside your rectangle.



Step 5. If  = 1, what is the area of the rectangle you built in Step 3?

12

Step 6. What fraction of the total rectangle is your small rectangle?

$\frac{1}{12}$

Step 7.

$\frac{1}{4} \times \frac{1}{3} =$ $\frac{1}{12}$

Use this sample type of procedure to multiply these fractions.

1.

$\frac{1}{2} \times \frac{1}{3} =$ ____________

2.

$\frac{1}{4} \times \frac{2}{3} =$ ____________

3.

$\frac{3}{4} \times \frac{2}{3} =$ ____________

1190

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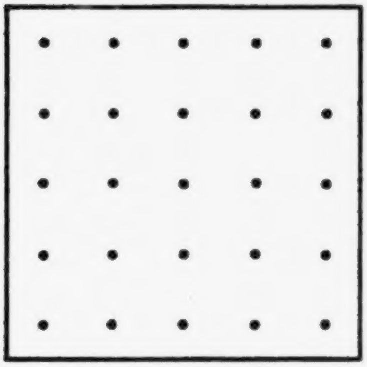
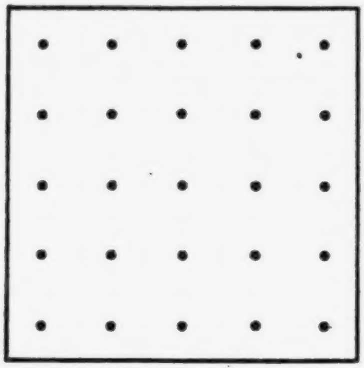
Area of Squares – Square Hunt

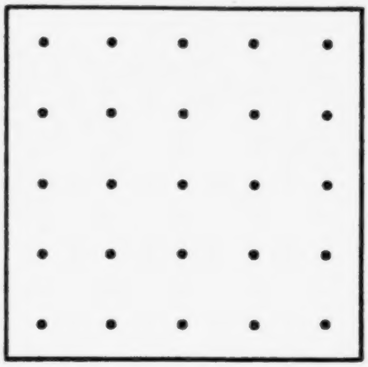
Try to construct a square with each of the given areas on your geoboard. Sketch your answers below. Three of these values are impossible. Compare your squares with your classmates.



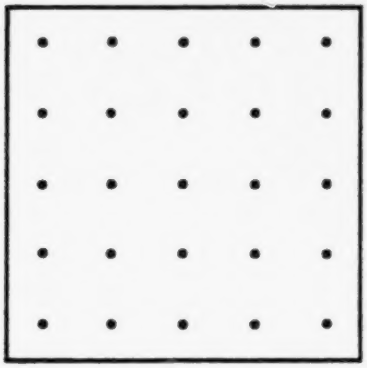
1. Area = 1 square unit



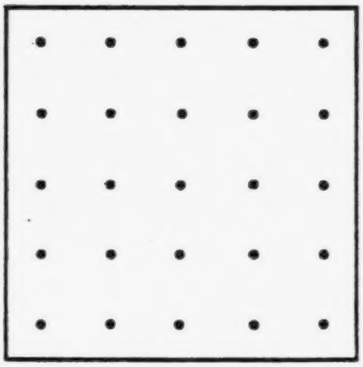
2. Area = 2 square units



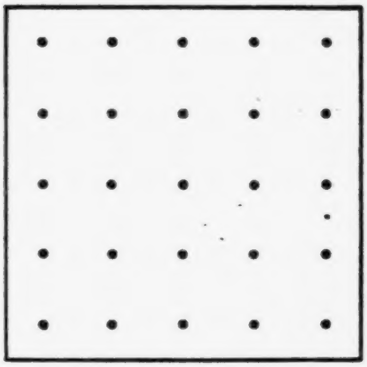
3. Area = 3 square units



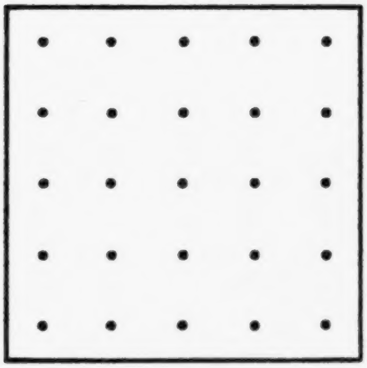
4. Area = 4 square units



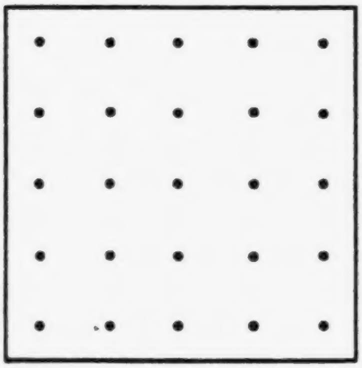
5. Area = 5 square units



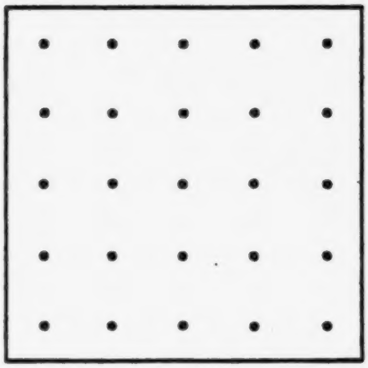
6. Area = 6 square units



7. Area = 7 square units



8. Area = 8 square units



9. Area = 9 square units

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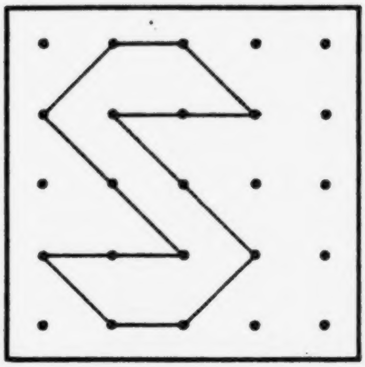
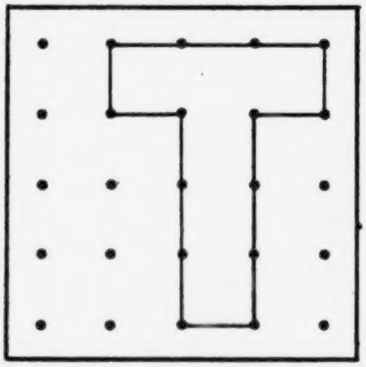
Alphabet Area, S-Z

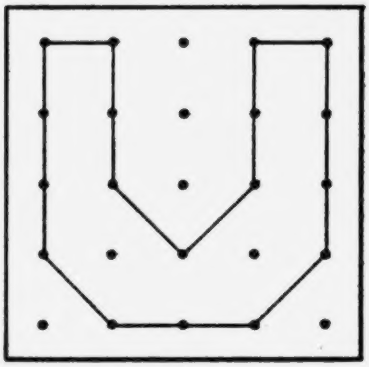
Estimate and then find the area of each of these geoboard letters.



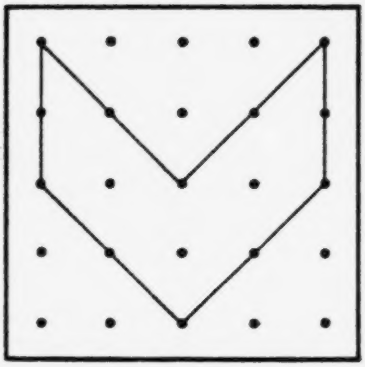
1. Estimated Area: ________
Actual Area: ________



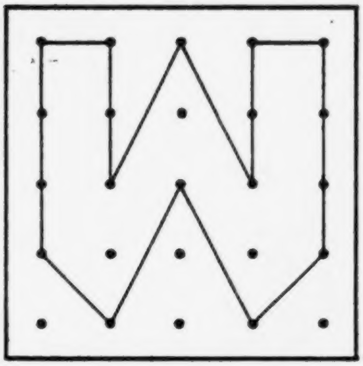
2. Estimated Area: ________
Actual Area: ________



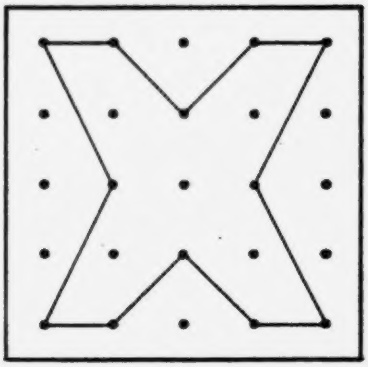
3. Estimated Area: ________
Actual Area: ________



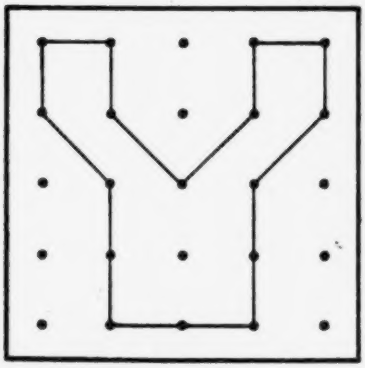
4. Estimated Area: ________
Actual Area: ________



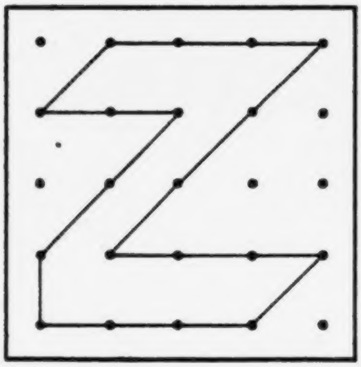
5. Estimated Area: ________
Actual Area: ________



6. Estimated Area: ________
Actual Area: ________



7. Estimated Area: ________
Actual Area: ________



8. Estimated Area: ________
Actual Area: ________

9. Write your first name in geoboard letters on a sheet of dot paper. What is the total area of your first name? ________

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Multiplication Challenges

Start each problem below by trying to guess the missing digit(s).
Then check your guess with a calculator.
Score one point for each correct guess.

1) _2 × 49 3038	2) _7 × 43 2021	3) _8 × 81 3078	4) _4 × 29 1856
5) 82 × _2 4264	6) 68 × _7 1836	7) 47 × _9 3243	8) 53 × _2 3816
9) _4 × 7_ 5624	10) _8 × 3_ 1632	11) _6 × 8_ 6966	12) _2 × 9_ 3948
13) 8_ × __ 3182	14) 2_ × __ 858	15) 4_ × __ 1568	16) 6_ × __ 4536
17) __ × 1_ 1513	18) __ × 4_ 2209	19) __ × 9_ 3276	20) __ × 5_ 4131

My Score: ____________

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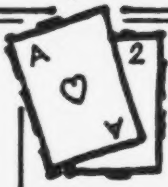
Coupon Sale

1) The store manager has made some mistakes in figuring the percentage for his coupon sale. Use your calculator to find his mistakes.

Coupon
Save 43%
67c Reg. 1.17
Windshield Washer Fluid
One gal. Limit 2 please

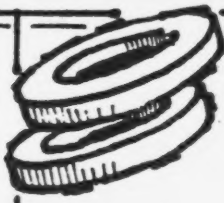
Coupon
Save 22%
69c Reg. 89¢
Chocolate Candy
Bridge mix, 12 oz. Limit 2 please

Coupon
Save 52%
66c Reg. 1.37
Hand Lotion, 10oz.
Limit 1



Coupon
Save 37%
2/59c Reg. 2/98
Plastic coated Playing Cards
Limit 2 decks

Coupon
Save 29%
99c Reg. 1.39
C-126-12 color print film
Limit 2



Coupon
Save 50%
88c Reg. 1.79
Twin Pak Masking Tape
with two yd. rolls ¾" and 1½"

2) How much would you spend at this store if you purchased the limit available at this sale price? ______

3) In buying the limit available, how much money would you save off the regular price? ______
What percentage of saving is this? ______

4) What is the area of one roll of 3/4" masking tape in square yards? ______
In square inches? ______

5) What is the price per ounce of the chocolate candy at the regular price? ______ At the sale price? ______

6) Suppose the store sold 16,000 decks of cards during this sale. How much money did they take in at 2/59¢? ______ How does this total compare with 16,000 decks sold at the regular price? ______

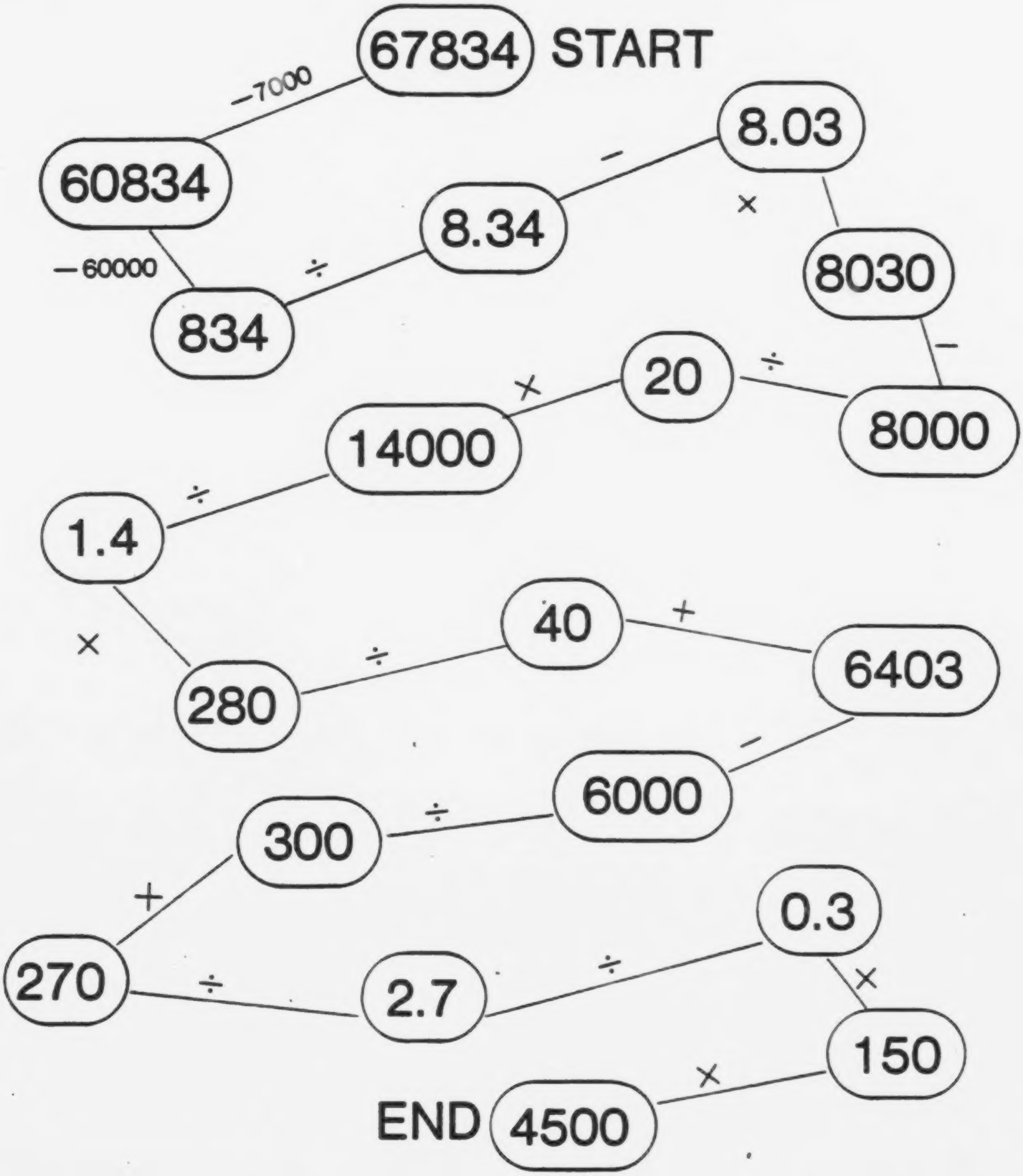
What do you think of the manager?

1194

Mental Computation

Enter the start number into your calculator.
Then enter the operation shown (+, −, ×, or ÷) and the number you think will give you the next number.
Continue until you make a mistake. You must then start over.

Experts: Get your calculator to go from End to Start.


67834 START
−7000
60834
−60000
834
÷
8.34
−
8.03
×
8030
−
8000
÷
20
×
14000
÷
1.4
×
280
÷
40
+
6403
−
6000
÷
300
+
270
÷
2.7
÷
0.3
×
150
×
END 4500

Find The Best Estimate

1. Mark a ✓ next to the number that you estimate to be closest to the actual answer.
2. Then use a calculator to find the actual answer and write it in the ring.
3. Score 1 point for each correct estimate.

X	72	58	36
28	1400 ✓2000 2016 2300 1700	1100 1700 1600 2000	600 1000 800 1200
41	3000 2700 3300 2500	2000 3000 2400 2800	1500 1300 1800 2000
67	4200 5300 4800 3800	3200 2400 2000 3900	3000 2400 1900 2100
83	5200 5000 6400 6000	4000 5100 4800 4300	3000 3600 2500 3300
19	1200 900 1700 1400	1000 1100 1200 1300	300 500 700 600
94	6800 6300 7200 7600	4600 5100 4800 5400	3400 2800 3900 3000
36	2000 2300 2900 2600	1500 2100 1700 1900	1000 1100 1300 1700

My Score: ______________

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Estimation Game

2-4 players take turns being the leader.

Leader: Pick a set (A, B, C, D, E, or F). Then secretly pick two numbers from that set (one which is circled and one in a square). Multiply the two numbers with a calculator. Tell (write) the other players the set and the product. Players guessing both secret numbers score 1 point.

The first Player to score 6 points wins the game.

A

㉜	㊷	(62)
$\boxed{48}$	$\boxed{78}$	$\boxed{88}$

B

⑯	㊻	(76)
$\boxed{28}$	$\boxed{48}$	$\boxed{88}$

C

⑧	㊳	(68)
$\boxed{62}$	$\boxed{82}$	$\boxed{112}$

D

㊴	(59)	(69)
$\boxed{91}$	$\boxed{71}$	$\boxed{61}$

E

⑮	㊺	(95)
$\boxed{65}$	$\boxed{75}$	$\boxed{85}$

F

㉔	㊹	(84)
$\boxed{84}$	$\boxed{44}$	$\boxed{24}$

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THINK ABOUT THIS!

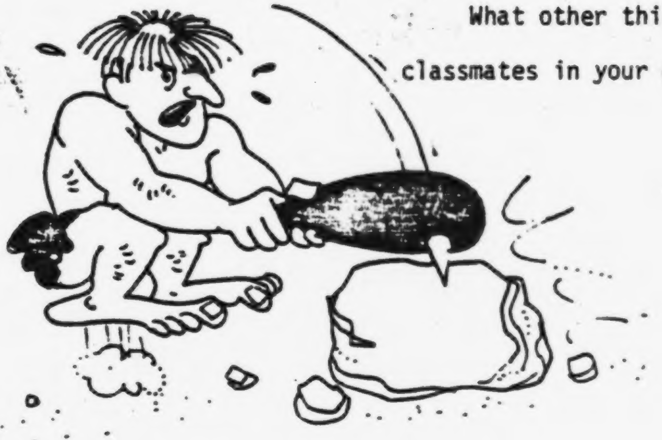
B49

Are you the oldest child in your family? The youngest child? In-between?

Whatever you are, are there others in your class like you?

Make a record of your own and your classmates' situations.

What other things do you have in common with classmates in your group?



THINK ABOUT THIS!

B46

Make a pendulum that takes one second to complete a one-way swing. Now guess at what you'd have to do to get the pendulum to take two seconds for a one-way swing.

Test your guess. Try for three, four, five-second pendulum clocks.

WORD PROBLEMS C31

This game requires one Mystery Man and one or more Detectives.

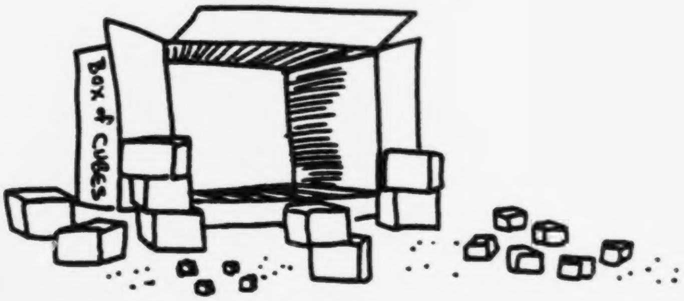
The Mystery Man writes a five letter word - the Mystery Word - on a piece of paper. The Detectives then tells the Mystery Man various five letter words of their own choosing. For each word, the Mystery Man tells how many letters match the Mystery Word.

(For example, if the Mystery Word were RADIO and the Detective says CATCH, the Mystery man would say "one.")

Players take turns telling the Mystery Man their words. The first Detective to guess the Mystery Word becomes the new Mystery Man.

GEOMETRIC PUZZLERS C60

Get a collection of small colored cubes - say 6 of each of red, green, white, blue, yellow and orange (or any 6 colors). With those cubes, can you make a 3 by 3 cube so that there is no place where the same color cubes are touching, facewise, or edgewise? (Cornerwise is OK.)



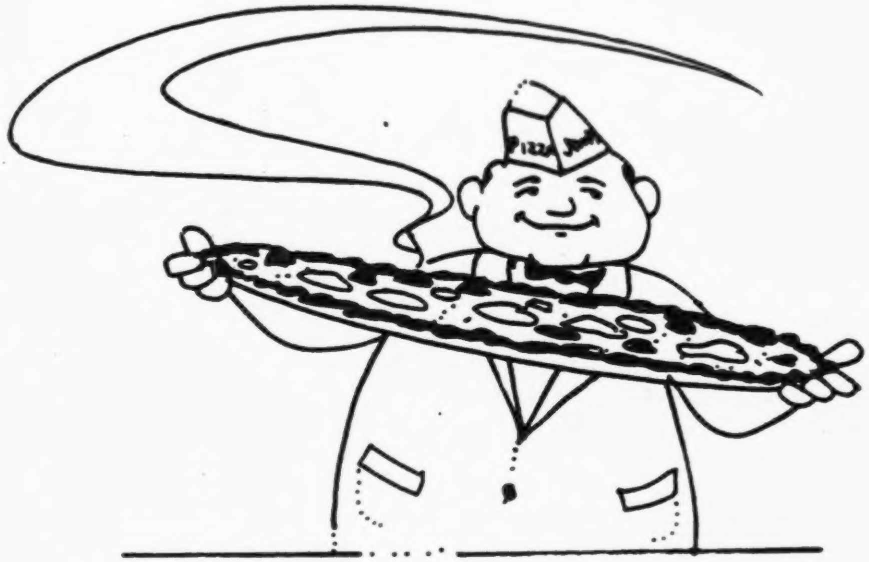
What's the smallest number of colors you need?

ABOUT MONEY:

D11

A 15 cm pizza (7.5 cm radius) is just about enough for one person. What size pizza should be ordered if your family has:

A. 2 people?
B. 4 people?
C. 12 people?
D. 80 people?



THOUGHT GAMES

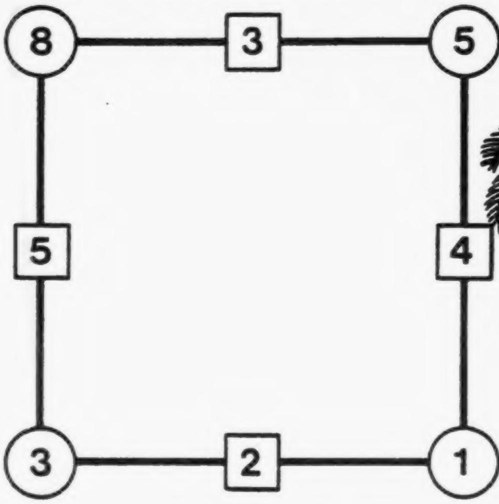
E72

Form two teams of four or five students. Then locate (but not necessarily bring to your classroom) the following items. The first team to locate all of the items is the winner.

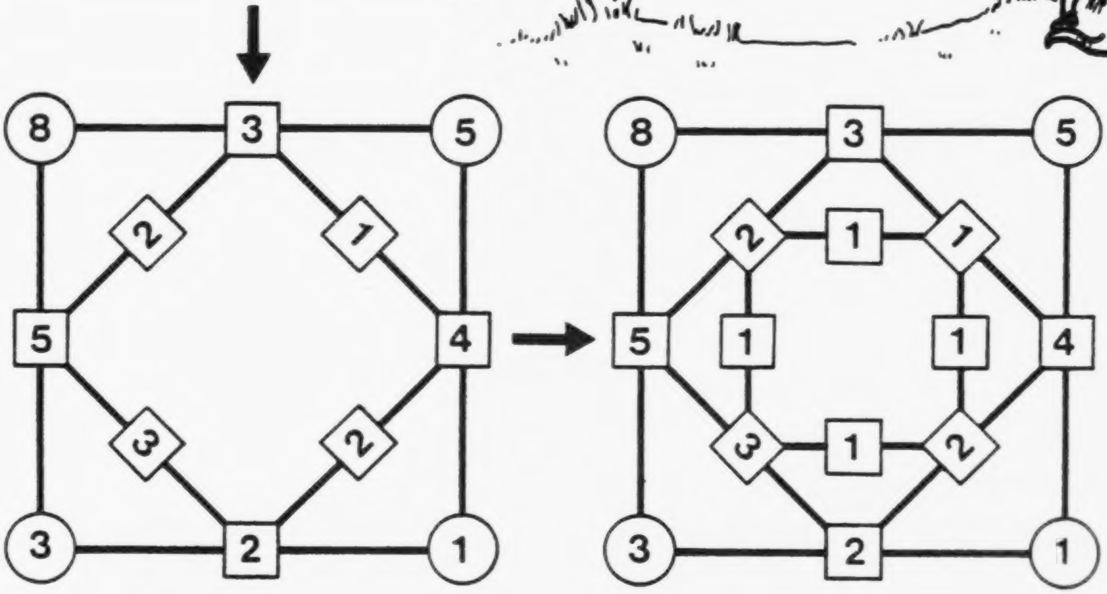
1. Five advertisements from a foreign magazine
2. A 1957 Volkswagen
3. An out-of-town newspaper
4. A family photo when your parents were young
5. A license plate from Nebraska
6. A license plate from Ohio
7. A unicycle
8. Six foreign coins
9. Four restaurant menus
10. A newspaper at least ten years old

NEBRASKA
00
X123
OHIO
JOE'S PLACE MENU
NEWS

Differences for Ever

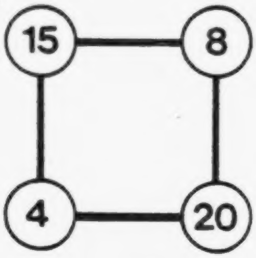


I think and plan and work, you just eat: that's the difference between us.
?

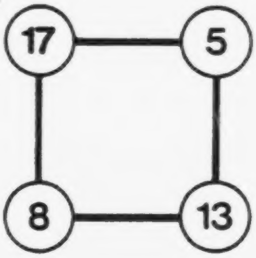

8
3
5
2
1
5
4
3
2
3
2
1
8
3
5
2
1
1
5
1
1
4
3
1
2
3
2
1

1 Keep finding the differences in the same way.

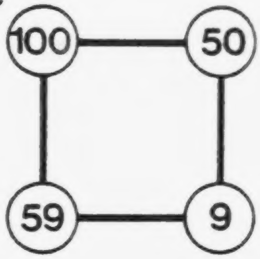
a



b

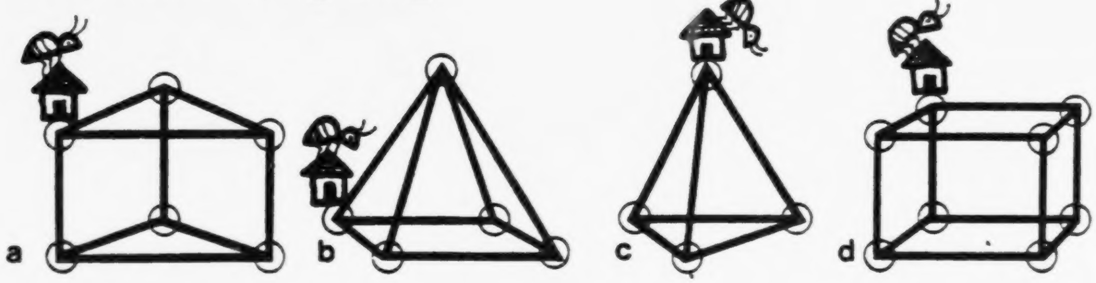


c



2 Experiment with any 4 numbers. Can you reach 7 differences?

The Wandering Bug

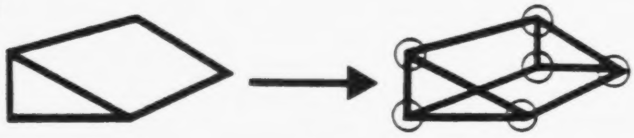


1 The bug goes for the longest possible walk and returns home.
The bug can crawl along any edge once only.
But it can visit a corner more than once.
What is the greatest number of edges he can walk along?

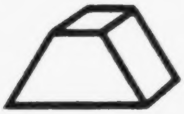
shape	edges walked	edges missed	total edges
a	6		
b			

2 How many sticks (edges) and corners (vertices) are needed to make these:

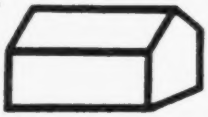
a



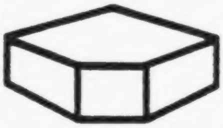
b



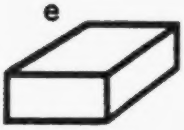
c



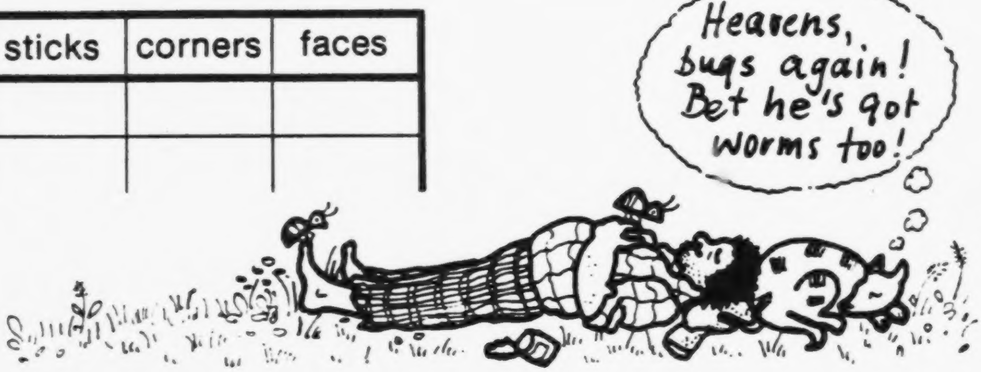
d



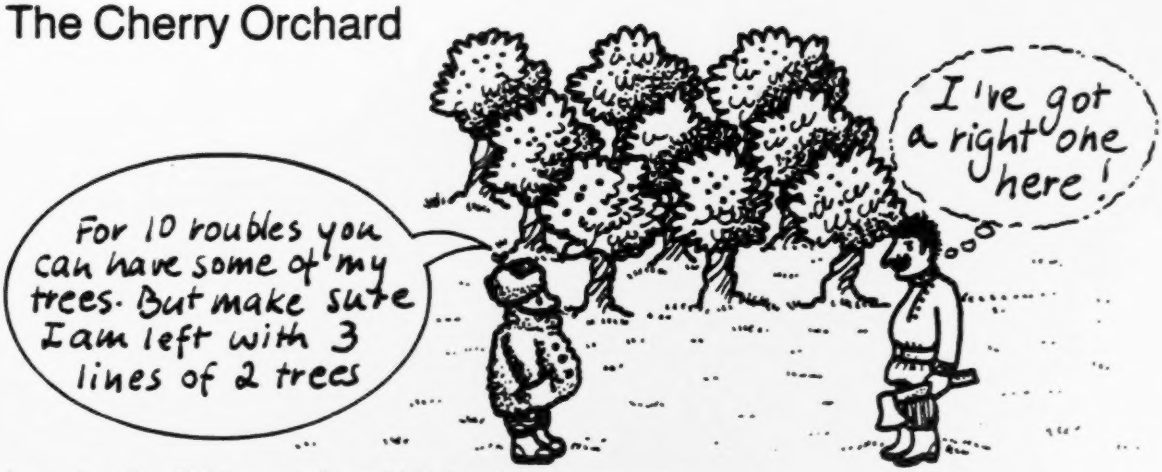
e



shape	sticks	corners	faces
a			
b			


Heavens, bugs again! Bet he's got worms too!

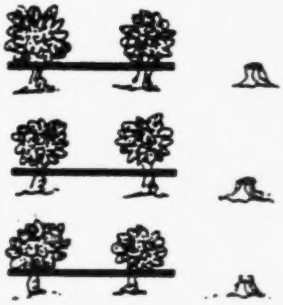
The Cherry Orchard


For 10 roubles you can have some of my trees. But make sure I am left with 3 lines of 2 trees
I've got a right one here!

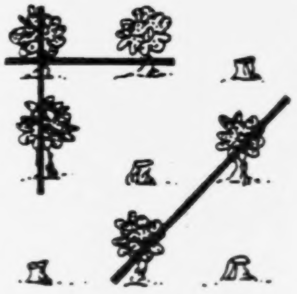
Ivan had a 9-tree orchard laid out in a square.

Ivan worked out that this way Boris would only get 3 trees.

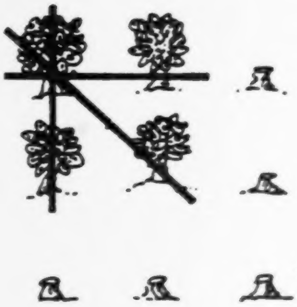
Poor fool, little did he know of Boris and his crafty ways.



3 trees axed



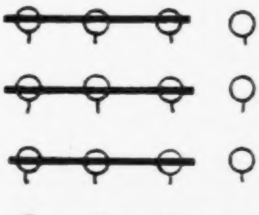
4 trees axed



5 trees axed
Which is what Boris did!

1 With his square 16-tree orchard Ivan asked Boris to leave him 4 lines of 3 trees.

He was hoping for this:



Show all the other ways.

Which gives Boris the most trees?

2 Look at the same problem with Ivan's square 25-tree orchard.

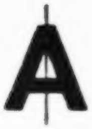
This time 5 lines of 4 trees are to be left for Ivan.

Symmetry

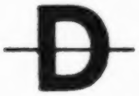
A B C D E F G H I J K
L M N O P Q R S T U V
W X Y Z

1 Sort the letters into those that

a Have a vertical (up and down) line of symmetry.

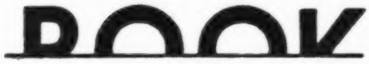


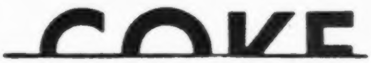
b Have a horizontal (across) line of symmetry.

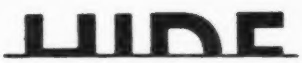


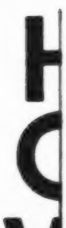
c Which letters are you left with?

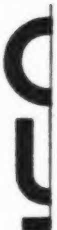
2 Here are some 'symmetrical' words. What are they?











Find 5 other words of each kind.

2 The game of 'Target'.

Rules: You can only press these buttons:

$\boxed{7}\ \boxed{3}\ \boxed{\times}\ \boxed{-}\ \boxed{=}$

Use them to make the calculator show each of the numbers from 0 to 9.

Do it in as few button pressings as possible.

First prepare a grid like this:

To make 1 ⟶ $\boxed{7}\ \boxed{-}\ \boxed{3}\ \boxed{=}\ \boxed{-}\ \boxed{3}\ \boxed{=}$ ☐ ☐ ☐ ☐

To make 2 ⟶ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

The game of 'Busted Calculator'.

3 The $\boxed{\times}$ button is out of action.

Try to find answers to these:

a	15×3	**b**	78×2	**c**	154×3
d	37×9	**e**	53×12	**f**	73×19

4 The $\boxed{\div}$ button is out of action.

Try to find answers to these:

a 6÷3 **b** 24÷8 **c** 28÷7

5 Make up your own 'Busted Calculator' puzzles.

II. Children's own problems

Once the stage has been reached when children are fully aware of the implications of our place-value number system, and are also confident in the computational processes, they usually show a tendency to enjoy the use of large numbers, introducing them for the sheer pleasure of working with them. When given the opportunity to invent problems for themselves (they will often do this of their own accord) they frequently produce problems of greater interest than those they are set. For example, a class of ten-year-olds was asked to find any interesting fact and to make a problem about this fact. (These problems were collected in a book called 'Fact and Fancy' which contained problems of special interest; the large majority involved very large numbers). One boy wrote: Fact: 'The sun is 93 million miles from the earth. Fancy: how long would a man, running at a speed of 1 mile in 4 minutes, take to run to the sun'?

The boy worked the problem and found the answer to be 707 years, 278 days, 8 hours (sic), and wrote: 'But he would have been dead long before that'.

Another group of ten-year-olds set out to find the number of grains of wheat demanded by the inventor of the game of chess who asked, as his reward, for 1 grain of wheat on the first square of the chessboard, 2 on the second, 4 on the third, and so on, doubling the number on the previous square until the 64th square was reached. The children were not daunted by the problem but, as the number they obtained was so unexpectedly large, they decided to have this checked by a computer. It was six months before they received the answer, and they wrote 'We got our answer right but the computer took longer than we did'. They also determined the necessary length of a granary to store the wheat if it were a mile wide and a mile high. They found that it would stretch for 200 miles.

There are two fairly simple methods of finding out whether children at this stage (between seven and ten) understand computational processes when they are given these to do. These are: writing a story to embody a given piece of computation, and doing a piece of computation in several different ways. In fact these methods may precede (as well as accompany) the practice stage.

The two pieces of written work which follow describe and illustrate these methods. Both were written by girls at schools in Staffordshire. The first was written by an able girl of ten. The second was written by a girl of I.Q. just over 80.

1. STORY ARITHMETIC

At the end of every sum we write a story, no matter what kind of sum, add, subtract, divide or multiply. It has to be a sensible story to describe the numbers we have used.

Just setting numbers down as numbers means nothing, but writing a story makes them mean something. For example, $46 - 8 + 7 = 45$, that means nothing, but if I write a story and say that 46 people were on a bus, 8 people got off and 7 people got on the bus and there were 45 people then on the bus, that means something. We have had some very funny examples in our class sometimes. One pupil said two children weighed themselves on the scales, one weighed 3 lb. 8 oz. and the other child weighed 4 lb. 9 oz., altogether they weighed 8 lb. 1 oz., and our teacher wrote on this person's book: 'What clever babies'! Now, if you write a story like that you cannot understand the meaning of the sum[1]. You know how to do the sum but you do not know why you did it. Two years ago it would just be another sum in the Mechanical Book IV, but now that sum has a meaning for us. If you know you have to write a story at the end of the sum, you are thinking of the story as you do the sum, so it makes sense. Besides writing stories about sums, sometimes we also explain how we have done a sum, and do the sum in as many different ways as we can.

---

[1] What the girl did not appreciate was that such a story sum showed lack of experience with real situations and not lack of understanding.

2. WAYS OF MULTIPLYING

2s. 11d. × 6 = 17s. 6d.

The first way: $\boxed{2/-} + \boxed{11d.} \times 6 =$

2s. 0d. × 6 = 12s. 0d.
11d. × 6 = 5s. 6d.

17s. 6d.

The fourth way:

s.	d.
2	11
2	11
2	11
2	11
2	11
2	11
17	6
5	66

My Story

One day my father went to put 2s. 11d. on a horse and the man times it by 6. So there was 17s. 6d. to come back to my Dad because the horse won. I don't like this story because my Dad would put 3s. 0d. on a horse, not 2s. 11d.

For 2s. 11d. I could get a pair of stockings but I don't want six pairs at once so that would be silly. I have seen a cake for 2s. 11d. and I could buy six for my party. The last way I added it takes long. I couldn't have multiplied 2s. 11d. + 2s. 11d., + 3s. 11d., but they were all 2s. 11d. so I could.

The last example shows, without a shadow of doubt, that the second girl had complete insight into the operation of multiplication. It also underlines the need to allow flexibility of method. This is not to say that children should not know one efficient method of performing each kind of operation but it does mean that, in the learning stage, variety of method may help towards understanding. Therefore children should be encouraged sometimes to solve a problem (and even a piece of computation) in a variety of ways.

Discussion of the methods used would of course follow to focus attention on the most efficient methods

III. Applications of the number system to the real world

1. MEASUREMENT

Experience with money, weight and measures will continue throughout the junior school, experiences increasing in scope and variety. In general, very rarely are more than two successive units used in real situations. A gram does not normally matter to an elephant and probably a kilogram does not matter either! The experiences involving measurement which are devised by the teacher for the children should, therefore, serve to illustrate the distinction between a count (made in answer to a question such as: How many children are there in this class? pencils in this box? children in the school?) and a measurement (made in answer to a question such as: Is this room a square? How heavy are you? What is the difference in weight between the lightest and the heaviest in the class?). The children need experience of the widest possible range of measuring instruments. For example, in length, they need to find the width of thin things like a post card and a sheet of paper, as well as finding longer lengths such as the distance across the playground, the distance they walk to school, the distance to the next town, the distance to London and the distance round the Equator. From such experiences children will come to realise that there is an appropriate unit for the different ranges of lengths and that to give an answer involving kilometres and centimetres is not usually sensible. They can only discover this through their own personal experiences. Similar experiences can be planned for weight, for time, etc. Too many questions in selection tests have been set involving days, hours and minutes or hours, minutes and seconds!

These varied experiences should cover the operations of addition, subtraction, multiplication and division. There is no reason why all of these experiences should be real, once the children show that they understand fully what they are doing. They will then, of course, require some problem practice and computational practice to fix the concepts and to maintain facility.

Before passing on to other important mathematical ideas which can arise out of children's real experience with weights and measures, we include a sequence of events which took place

6

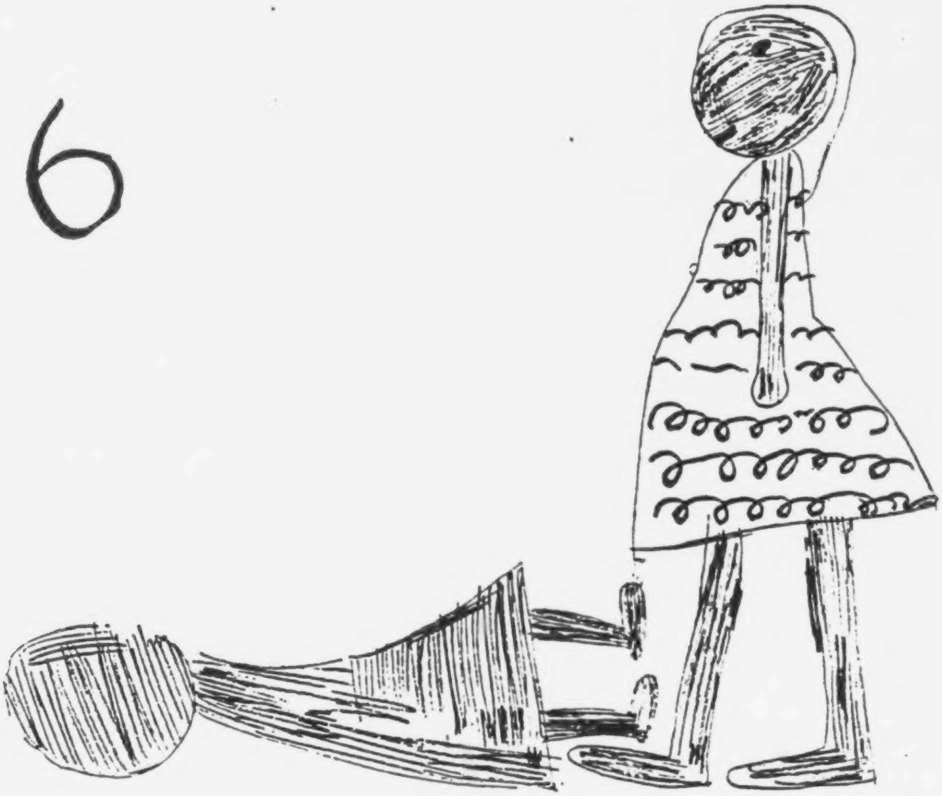


Fig. 4.11

with children of different ages concerned with the same topic: 'shadows'. This sequence is important because it shows how the same topic, tackled by children of very different ages, will be pursued as far as the children's abilities and development allow, provided the teacher gives the right kind of encouragement and guidance.

The first example occurred with some young five-year-olds who had been chasing their shadows one day. Noticing their interest their teacher suggested that they should chalk in the shadow of a pole in the playground at each hour during the day. At nine o'clock they all watched one boy draw a line along the shadow. They then chose two boys to draw the shadow at ten o'clock. An hour later the teacher was hearing a girl read when she was disturbed by an angry voice saying: 'You moved it'. 'Moved what?' she asked. Ignoring the question the angry voice repeated: 'You moved it. I'm going to sit here and watch you for an hour so that you can't move it next time'. With some concealed amusement the teacher collected the children together and they sat in the sunshine for some time, watching the shadow of the stick move. At this stage wisely she did no more.

A six-year-old girl made the following record:

Me and my shadow.

	Me	*Shadow*
10 a.m.	4′ 4″	4′ 10″
11 a.m.	4′ 4″	3′ 10″
Noon	4′ 4″	3′ 8″

Figure 4.11 is taken from the illustration which accompanied this. As the record suggests, this six-year-old actually measured her height each hour to make sure that she had not grown during the interval.

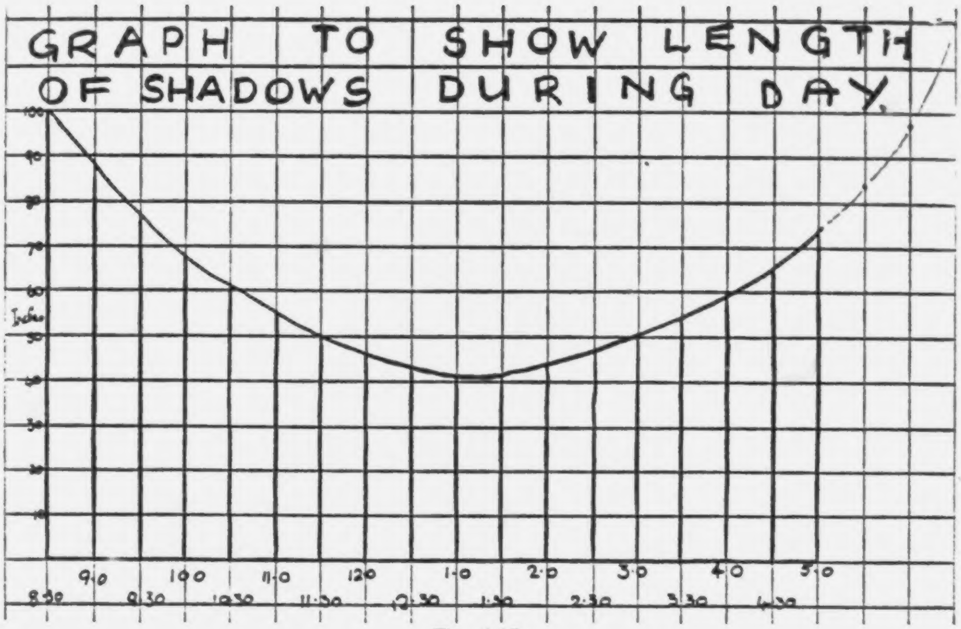


Fig. 4.12

The third example, 'Measuring the smallest boy's shadow' was written by a nine-year-old boy. It begins: 'At ten o'clock I measured the smallest boy's shadow it was 57 ins. His proper height is 50½ ins. His shadow was 6½ ins. longer. At quarter past ten his shadow was 54½ ins. It had gone down 2½ ins. I used the exact spot every time. I am measuring his shadow every quarter of an hour' . . . The results were represented on a block graph showing the length of the boy's shadow from 10 a.m. to 2.30 p.m. at 15 minute intervals. The booklet also contained 17 questions with the statement: You will find that the answers to these questions can be found on the graph.

1. At what time was his shadow smallest?
   What is the difference between the lowest height of his shadow and his proper height?

The final piece of work, 'The Sun's Shadow' was the work of a ten-year-old. It begins with an illustrated account, obviously adapted from a book, of the sun's 'passage' across the sky on December 21st and June 21st. This was followed by a scale diagram showing the measurements and direction of the shadow of a stick taken from 8.30 a.m. to 5 p.m. at half-hourly intervals. The work concluded with the line graph reproduced in Fig. 4.12. An attempt had been made to continue the curved line joining the extremities of the columns as though the child had tried to predict what would happen after observations ceased. (Fig. 4.12).

2. AVERAGES

Children can experience the meaning of an average without first being told what to do. For example, each of a group of four seven-year-olds was given a few wrapped sweets, the teacher taking care that each had a different number (e.g. 3, 5, 6, 10) and that, in the first instance, the total was divisible by 4. She then asked the children what they could do so that each would have the same number of sweets. Unhesitating they collected the sweets together and shared them equally amongst the group.

Some ten-year-olds were asked to group themselves in fours. Each child was weighed and the teacher asked them which group was the heaviest. Naturally, to find the answer, each group added the weights of the children in the group. They found the heaviest group, the lightest group, and the difference between these groups. The teacher then asked each group to find the weight each member of the group would be if they all weighed exactly the same and the total weight was unaltered.

On another occasion when the children were grouped as before, they were asked to find the height of each child in the group. Each child was then asked to cut off a length of paper equal to his own height. This time the groups were asked, 'If the children in your group lay down on the floor head to foot which group would stretch the farthest? Would you reach the hall ceiling if you were able to stand on each others' heads?' The children fastened their strips together to find the answer and then measured the total length. When the teacher asked them to find the height each child in each group would be if all were of exactly the same height, they decided to fold the long strip into four to find the answer.

The teacher then introduced the word 'average' and asked the children how they would find the average height of the whole class. At this stage the children themselves suggested first finding the total height and then dividing by the number of children in the class. They then took their strips, and arranged them in order, beginning with the smallest, and fixed them to a piece of brown paper on the wall. They marked in the average and each child worked out how much below the average or above the average his height was. They were given a shorthand way of writing this, − for below and + for above the average. When the children were asked what they thought the average height meant, they were able to say it was the height each would be if they were all the same height. The teacher next asked them if they could suggest a way of testing whether the average height they had found for the whole class was really the height each would be. They cut off the pieces of paper above the average and fitted them into the spaces left by the strips which did not reach the average, dividing them where necessary. They were delighted to find that the pieces fitted exactly.

Later this experience gave the children an idea to save themselves some work. They noticed that the shortest child was 4 ft. 6 ins. and so decided to add up all the heights above 4 ft. 6 ins., divide this by the total number of children, and add it to 4 ft. 6 ins. Later still, when the children were being questioned on their 'graph of heights,' one boy said that if he took 4 ft. 9 ins. as his 'line' he could write down the differences above and below and share out the total and add or subtract this from 4 ft. 9 ins. His experiences had in fact led him to discover the statistical method (a most efficient method) of calculating averages.

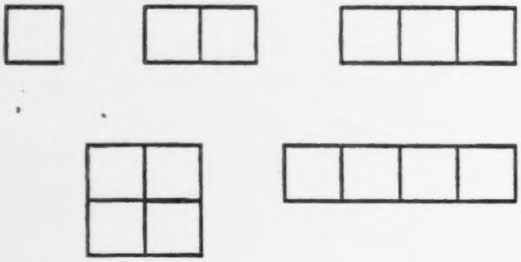


Fig. 4.13

3. Ratio, Proportion and Rate

These three related topics form a familiar part of everyday experience and yet ratio and rate are usually avoided until the secondary stage and proportion is often taught merely as a method (the 'unitary' method). In consequence these topics cause unnecessary difficulties partly because of an inadequate (or even misleading) vocabulary.

We often use the concept of *ratio* when we need to compare two (or more) numbers or quantities (frequently lengths) as the following examples show. Some six-year-olds made a model to illustrate the incidence of birthdays in the class. They marked the months in order on a piece of paper and put one match box in the appropriate column to mark the birthday of every child in the class. One six-year-old wrote: 'There are twice as many birthdays in November as in July'. This was a comparison of the number of birthdays in the two months and was therefore a natural use of the idea of ratio.

One teacher used squares of the same size to introduce a group of children to the idea of ratio. The children made rectangular shapes with one, two, three, four squares (and so on) (Fig. 4.13). After some discussion the word ratio was introduced.

Using one square, the ratio of the length to the width is one to one (written $\frac{1}{1}$ or 1 : 1).

Using two squares, the ratio of the length to the width is two to one ($\frac{2}{1}$ or 2 : 1),

and the ratio of the width to the length is one to two ($\frac{1}{2}$ or 1 : 2).

The use of the word ratio is much simpler here than the alternative which the teacher first used: how many times the width is the length? (She also asked: What fraction of the length is the width?) The word ratio should be used naturally and frequently in such comparisons.

Some nine-year-olds enjoyed recording the 'ratio of rotundity' for the children in their class and for the adults they knew—for this they compared each person's height with his waist measurement. (They soon discovered that to make these measurements to the nearest inch was a sensible degree of accuracy). For example, the teacher's height was 5 ft. 10 ins. and his waist measurement was 30 ins. The children recorded:

His ratio of rotundity is $\frac{70}{30}$ or $\frac{7}{3}$ or $2\frac{1}{3}$.

One boy's measurements were:
height 4 ft. 10 ins., waist 2 ft.
He found his ratio of rotundity to be $\frac{58}{24}$ or $\frac{29}{12}$ or $2\frac{5}{12}$.
At the end of a series of recordings the boy wrote:

'Although all the people we measured were different ages and sizes their ratio of rotundity was almost the same'.

A girl added: 'The answer always came to between 2 and 3 whole ones'. (It would have been interesting to record also the ratio of the weights of the people measured, for example of the teacher and the boy.)

A group of ten-year-olds were making arrows for a performance of Robin Hood. Some arrows (willow sticks with 'feathers' of cardboard) flew through the air much more effectively than others. The children began to examine the 'balance' of each arrow, using their hands to find the point of balance. The arrows were of different lengths and they wanted to make a comparison—but they had difficulty in describing what they wanted to compare. They demonstrated that it was the two lengths into which the point of balance divided the length that they needed to compare. To help them the teacher chose the smallest girl (of known height 52 in.) and asked them if she, the teacher, was twice as tall as the girl. There was much merriment as they realised how tall this would make the teacher whose height they knew to be 5 ft. 10 inches. The teacher then introduced the word ratio and the children suggested that the ratio of their heights would be about 70 to 50 or 7 to 5.

Many similar examples, using numbers, money and measures of all kinds, will arise naturally or can be contrived easily. Some important illustrations of ratio will be found in Chapter 6 (the circumference/diameter ratio of a circle) and in Chapter 7 (a simple approach to density).

Proportion is another familiar topic in the environment. Children ask many questions which involve the idea of proportion and often solve these in their own way, using their common sense. Such problems as the following, asked by teachers of their children, have all been solved by children of primary school age.

(1) How heavy is a pint of water?
How heavy is a gallon of water?
(One weighing only was done).

(2) What weight of water is wasted in 24 hours by the dripping tap in the cloakroom?

This is how an eight-year-old described what she did.

'First I got a measuring tin. Then I put it under the tap. A $\frac{1}{4}$ of a pint was wasted in $\frac{1}{2}$ an hour. This weighed 5 ozs. 10 ozs of water in 1 hour. 10 ozs. × 24 = 240 oz. I then divided 240 by 16. There are 15 × 16 in 240. So the answer is 15 lb. in one day'.

(3) Find the distance you cover in 8 even paces. How long is one pace (assuming your paces are all of the same length)?

Some slow nine-year-olds who were tackling this problem could not see what to do to find the length of one pace. So they were asked to measure the length of 2 paces. They immediately suggested halving this to find the length of one pace. They then measured the length of 4 paces and suggested dividing by 4 to find the length of one pace. This additional experience helped them to see that they must divide 19 ft. 8 ins. (the length of 8 paces) by 8 to find the length of one pace: 2 ft. 4 ins. The children's next exercise was to 'pace' the length of the playground and, using the length of pace they had worked out, to find the length of the playground (which they afterwards measured using a surveyor's tape).

Many similar examples, involving money, weights and measures, will be suggested by the children, as well as by the teacher. The concept of proportion is also of great importance in geometry; this is discussed fully in the next chapter as 'mathematical similarity'.

Children's first experience of the third of the three related topics, *rate*, is price, and the second is usually speed. Two variables are associated with rates. For example, price is the rate of buying a commodity, e.g. 10p for 100 grams of sweets or of tea; 5p for 1 litre of petrol. Speed is the rate of covering distance so that the two variables are the distance covered and the time for the journey. Children have many experiences with money and with the price of various commodities. We shall therefore confine our illustrations to those concerning speed.

There are two ways of considering speed; the simplest aspect is that used in athletics. How long does it take to run a measured distance? This is usually the aspect which young children first consider, as the following example will show. In a class of six-year-olds Timothy, a tortoise, was brought to school one morning. Someone asked Peter, his master, 'How fast does Timothy go?' Peter put a yardstick on the floor and held Timothy at one end. The teacher had a watch with a second hand which she allowed the questioner to use. When he said, 'Go', Peter released the tortoise. Surprisingly Timothy walked obediently beside the yardstick. He completed the measured yard in 2 minutes 55 seconds.

It happened that in the next class a second tortoise had arrived that day. The children decided to find out which tortoise moved faster. They asked the other class to find out how long their tortoise would take to travel a yard. These children marked a chalk line a yard long on the floor and started the tortoise at one end. The second tortoise ignored the line altogether and took its own course. At first the children wondered what to do. Then its owner drew its path with a chalk line while another child cut a piece of string a yard long, and covered the chalk line with the piece of string. Unfortunately this tortoise became discouraged before he had completed the course and the problem was not solved.

Some nine-year-olds conducted a similar (but more systematic) investigation after they had collected some insects on a nature walk. They decided that they would find the time taken to cover a foot by all the insects they had collected. A piece of work on the caterpillar is quoted in full. (The children have assumed 'constant speed'.)

The Caterpillar

To go 1 foot the Caterpillar takes 45 seconds.
To go 1 yard it takes 45 × 3 seconds, which is equal to 135 seconds.
1 mile is equal to 135 × 1760 seconds.
Then you divide by 60 to get minutes and then by 60 again to get hours.
Answer = 66 hours.
66 hours = 2 days 18 hours.

It is a mile to the Guildhall and if the Caterpillar sets off at twelve o'clock on Monday it will reach the Guildhall at 6 o'clock on Thursday morning.
This does not allow for meals or sleeping.

The examples quoted are those in which the time taken to cover a measured distance is found. The second aspect, the more usual measure of speed, is to quote this in km per hour. This is done by finding the distance covered in a measured time. An eight-year-old wrote a book, as a record of her own experience, which she called: 'In two minutes I can'. The record contains such interesting and varied items as

skip round the hall 13 times
skip through a hoop 106 times
kick the ball round the hall 10 times.

The girl had made up problems on this for other children to do. One of these was: 'How many times can I skip round the hall in 12 minutes?'

Two girls aged eleven became interested in the speed of trains.[1] Their interest started with an electric railway with which they were playing at school. They decided to try to find the speed of a goods train which passed the school. On a map they marked two places half a mile apart on a straight length of rail. They first synchronised their watches and then took up their places at the appointed spots. As the train reached the first girl she noted the time. The second girl recorded the time as the front of the train reached her. Their record read that the train had taken 90 seconds to cover a half mile. They therefore said that in 3 minutes the train would cover a mile and since there were 3 minutes × 20 in an hour the train was therefore travelling at 20 miles an hour.

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[1] *Science in Primary Schools*, HMSO, 1961.

Now these girls were fortunate in that the time taken to cover the measured distance was an easy unit. If the time had been, for example, 1 minute 19 seconds the girls might well not have been able to work out the result. But using a ready reckoner graph of the time taken to cover a measured distance, the distance travelled in a simple unit of time could be read from the graph (to ensure that the calculation would be an easy one). Speed (or distance-time) graphs are an important aspect of mathematics and will be considered in Chapter 6.

4. SIMPLE STATISTICS

In a subsequent chapter contributions to the work in mathematics from other aspects of the curriculum will be considered. These will be seen to have relevance to the topics discussed in the present chapter. There is one branch of applied mathematics which has particular relevance to the work of young children: this is usually known as statistics. The scope and importance of the work can be judged from the following examples in which the simplest statistical methods were used.

The first example occurred in an infants' school with a large class of six-year-olds. The children had decided to count the number of dandelions on part of the lawn. The teacher discussed with them the difficulty of keeping count and asked them how they might mark the dandelions they had counted. One boy noticed that there were some white poppet beads on the teacher's desk (deliberately left there) so he suggested using these, putting one bead on each dandelion. After the children had set to work they discovered that there were several plantains on the lawn also. They wanted to include these in their count and to find out whether there were more dandelions than plantains. They found some yellow poppet beads to mark the plantains. At the end all the beads were collected and strung together. When the teacher held the two strings of beads for the children to see they said at once that there were more dandelions than plantains because the white string was longer than the yellow one. At that moment the teacher noticed that the white beads were slightly larger than the yellow ones. He did not point this out to the children but said, 'Are you sure that there are more white beads than yellow?' Most children maintained that there were more white beads, but one boy noticed that the beads were of different sizes and he said he was not sure, because the beads were not the same size. Even then many children stoutly maintained that there were more dandelions but a few said they thought they ought to count the beads. This proved very difficult (there were more than 60 of each of the beads on the two strings). Eventually the children decided to count the beads in tens and by a method of matching discovered that there were in fact seven more plantains than dandelions. These children had happily suggested and accepted the one-to-one correspondence involved in making their count.

A group of ten-year-olds undertook a simple sampling experiment. The children decided to investigate the incidence of weeds on a patch of lawn. The lawn was a large one and it was decided that to count the weeds on the whole lawn would be impossible. They identified four weeds and wrote their names in their notebooks. The teacher discussed with them ways of preventing the choice of those patches where most weeds occurred. They borrowed some wire frames, each made into a square foot, and used these to enclose a piece of lawn. They decided to drop the frames over their shoulders to prevent any tendency to choose a weedy patch. To avoid using the same piece of lawn more than once they each worked on one strip. If a weed was enclosed within the square it received a tick. (Only one tick was recorded for each square however many times the weed occurred.) Altogether fifty squares were examined by the group and the number of ticks against each weed was counted. A column graph of the result was made on squared paper so that the lengths of the lines showed the relative incidence of the four plants. When asked which weed was most abundant, the children unhesitatingly gave the right answer. They said that there are about seven times as many clover as yarrow. When the teacher asked them 'If we could have counted all the clover plants on the lawn and all the yarrow plants, how many times as many clover as yarrow plants would there have been?' The answer came immediately: 'Seven times'. (A big assumption was made here—one which it would have been interesting to substantiate using a smaller patch). The next step was to examine the football pitch which was a continuation of the lawn. There the children found that the proportions of the same four weeds were quite different.

Similar methods were used by another class of ten-year-olds in their investigation into the creatures contained in a pond. Twenty samples were taken in different parts of the pond (in the sun, in the shade, in the weeds, in moving water). Each small group chose a creature and recorded how many times in their twenty samples the creature was present. In this way they were able to determine which conditions their chosen creature preferred.

Sampling is a difficult idea and it is very doubtful whether the full implications can be realised until the children have had a very varied experience over a considerable period of time.

IV. Extension of ideas of number

1. FRACTIONS

So far, the children's knowledge of number has been mainly concerned with whole numbers (integers) which they first used to describe situations in their environment, and later learned to combine in different ways according to the operation demanded by the specific problem in hand. Gradually, through recording their experiences, they learned to relate the different operations—addition, subtraction, multiplication and division—to the appropriate symbols ($+\ -\ \times\ \div$) and eventually arrived at an efficient way of solving the different computational operations.

When, often at the same time as this growing knowledge of the way whole numbers behave, children meet parts of wholes or fractions, these occur so early and so frequently in their real experiences that they invent their own ways of dealing with them (and usually their methods are quite efficient). When they meet the written symbols for fractions, they are experiencing, for the first time, pairs of numbers used in a different way; number pairs which appear to behave differently from integers when combined by any of the operations addition, subtraction, multiplication and division. The symbolic way of writing fractions is more difficult than is sometimes supposed. Children can deal with fractions orally long before they can record their results in symbolic form. For example they know that three quarters and one quarter make four quarters or one whole before they are able to record it as $\frac{3}{4} + \frac{1}{4} = \frac{4}{4} = 1$. Once they have met the symbolic form and recorded their results in this way they need to be asked, at intervals, the meaning of the numerals such as 8 and 5 in $\frac{5}{8}$ to ensure that they thoroughly understand what they are doing. A variety of regular geometric shapes (in two colours) is often used for giving children varied opportunities for recognising the common fractions. In most of their experiences the fractions they meet should be the simple ones of everyday life and should therefore normally be restricted to those in common use: $\frac{1}{2}$, $\frac{1}{4}$, $\frac{3}{4}$, $\frac{1}{3}$, $\frac{2}{3}$, $\frac{1}{10}$, etc.

But sometimes children devise and enjoy experiences in which they come across far more complicated fractions as the following example shows.

A class of nine-year-olds were asked by their teacher to find the weight of a laurel leaf. A girl solved this problem by weighing an ounce of laurel leaves. She wrote:

41 of our leaves make 1 oz.
So 1 leaf is $\frac{1}{41}$ oz.

This investigation fired the imagination of the whole class and, between them, the children found the weights of a wide variety of small objects from a marble to a drawing pin. The recording was precise for one boy wrote:

4 similar marbles weigh 1 oz.
1 marble weighs $\frac{1}{4}$ oz.

and another wrote:

44 sweets make 1 oz.
So one is $\frac{1}{44}$ oz.

The children then turned their attention to finding the thickness of a variety of strands which they wound on card until the inch was obtained. A girl recorded:

24 strands of wool to 1 inch.
So thickness $= \frac{1}{24}$ inch

and a boy:

Thread 52 to 1 inch.
Thickness $\frac{1}{52}$ of 1 inch.

The finest strand was found to be nylon ($\frac{1}{82}$ of 1 inch) for which strands wound to $\frac{1}{4}''$ only were counted. The children concluded this investigation by finding the thickness of every type of paper in the stock cupboard.

The value of these experiments was not only in the excitement which they caused (and competition also—to find the lightest object and the finest thread). The children gained insight into the meaning of fractions and, in particular, an understanding of a difficult idea: although 40 is much greater than 4 (for example) $\frac{1}{40}$ is much smaller than $\frac{1}{4}$. This is an example of inverse proportion.

Once the nature of a fraction is understood, the only other concept concerning fractions which children need to discover and to understand is the equivalence of fractions. Again, this is a novel idea for them. Hitherto there has been no ambiguity about the recording of their experiences. When they make a count of five they record the answer verbally or in writing by the numeral. Now they find that $\frac{1}{2}$ can be represented by more fractions than they can count. Children are normally given wide experiences from which they can discover this equivalence of fractions. Much of this experience will concern measurement. The most usual way of focusing attention on equivalence is by means of a fraction board.

That young children can solve quite difficult examples mentally is illustrated by the following example. A seven-year-old, working on a model of Coventry Cathedral, decided to find the corresponding lengths in the original. The scale was 1/16th of an inch to 1 foot. He measured the height of the model chapel and found it to be $3\frac{3}{4}$ inches. He said, 'Each inch is the same as 16 feet, so 3 inches will mean 3 sixteens, that is 48. Half of 16 feet is 8 feet; that is 56 feet. One quarter of 16 feet is 4 feet; that is 60 feet altogether'.

Experience is needed in problems leading to all four operations in fractions. As already suggested, the methods will be varied and the recording will be done in an informal way. For example:

$$\begin{aligned} 3\tfrac{1}{2} + 1\tfrac{3}{4} \text{ will be worked as } 3\tfrac{2}{4} + 1\tfrac{3}{4} &= 3 + \tfrac{5}{4}\ (\tfrac{4}{4} = 1) \\ &= 4\tfrac{1}{4} \end{aligned}$$

The advantage of this simple method over the 'common denominator' method is even more striking when a difficult subtraction is performed.

$$\begin{aligned} 3\tfrac{1}{2} - 1\tfrac{3}{4} &= 3\tfrac{2}{4} - 1\tfrac{3}{4} \\ &= 2 + \tfrac{4}{4} + \tfrac{2}{4} - 1\tfrac{3}{4} \\ &= 1\tfrac{3}{4} \end{aligned}$$

Children will also solve simple problems involving multiplication and division of fractions in their own direct way. For example, an eight-year-old was asked to find the total length of five short lengths, each of $3\frac{1}{2}$ inches, and was asked to check this by an experiment. The girl said: five lengths of 3 in. is 15 in., five of $\frac{1}{2}$ in. is $2\frac{1}{2}$ in. The total length was $17\frac{1}{2}$ in. She then put the lengths end to end to see whether they would stretch to $17\frac{1}{2}$ in.

Even more complicated examples such as $5\frac{1}{4} \times 3\frac{1}{2}$ can be solved in this way. Once again we must be careful about our interpretation of the symbols in this operation and of the possible confusion between 'of' and 'multiply'. (See p. 22)

$5\frac{1}{4} \times 3\frac{1}{2}$ means $5\frac{1}{4}$ multiplied by $3\frac{1}{2}$ or

$$\begin{aligned} 3 \text{ of } 5\tfrac{1}{4} + \tfrac{1}{2} \text{ of } 5\tfrac{1}{4} &= 15\tfrac{3}{4} + 2\tfrac{5}{8} \\ &= 15\tfrac{6}{8} + 2\tfrac{5}{8} \\ &= 18\tfrac{3}{8} \end{aligned}$$

The 'top heavy' fraction method comes later:

$$\begin{aligned} 5\tfrac{1}{4} \times 3\tfrac{1}{2} &= \tfrac{21}{4} \times \tfrac{7}{2} \\ &= \tfrac{147}{8} \\ &= 18\tfrac{3}{8} \end{aligned}$$

Similarly, and more simply, we know that

$$\tfrac{1}{2} \text{ of } 3 = 1\tfrac{1}{2}$$
$$\text{and } 3 \times \tfrac{1}{2} = \tfrac{3}{2} \text{ or } 1\tfrac{1}{2}$$

Area problems will provide many useful examples which require multiplication of fractions.

In division, a girl who was not yet nine years old invented a very efficient method for dividing fractions. She was working a problem: $3\frac{3}{4} \div 1\frac{3}{4}$. She wrote: These are all quarters

$$15 \div 7 = 2\tfrac{1}{7}$$

When asked what she would do if she had to work $3\frac{3}{4} \div 1\frac{7}{8}$ she said, after some thought, 'I could turn them all to eighths couldn't I?'

She wrote: $3\frac{6}{8} \div 1\frac{3}{8}$

These are all eighths

$$30 \div 11 = 2\tfrac{8}{11}$$

This method obviates any need to teach children to 'turn upside down and multiply' and will meet any normal needs of the children, provided the fractions given are commensurate with reality.

When children are given problems such as: 'How many lengths of balsa wood, $1\frac{3}{4}$ in. long can be cut from an $11\frac{1}{2}$ ins. length?' The remainder sometimes creates a problem unless a simple method is used.

$$11\tfrac{1}{2} \div 1\tfrac{3}{4}$$
$$11\tfrac{2}{4} \div 1\tfrac{3}{4}$$

These are all quarters of an inch.

$46 \div 7 = 6$ and 4 quarters or 1 inch over.

Such a simple problem can always be checked by measuring. If this example is worked by the 'turn upside down and multiply' rule, the answer comes to be $6\frac{4}{7}$. It is difficult for children to understand that this $\frac{4}{7}$ relates to the length of $1\frac{3}{4}$ in. The simpler method is obviously better here and it is certainly one which children can discover for themselves.

Measurement will provide many opportunities for work with fractions and in the use of the four operations applied to fractions.

2. DECIMAL FRACTIONS

Now that we use a decimal money system, decimal fractions are likely to be introduced earlier than the correct norm (10 years old). The use of metric units of measurement will contribute to this. Some teachers introduce decimals once place-value is thoroughly understood, and as soon as children can extend our number system to the right.

1000	100	10	1	$\frac{1}{10}$	$\frac{1}{100}$
Shorthand forms:				0·1	0·01

It is important that decimals should be be introduced from their use in real situations. Children will already be accustomed to buying records at £1·25, £1·05, but, as with their counterparts in the U.S.A. will probably translate this to one pound 25 pence. They will, however, know that there are 100 pence in £1, so that the equivalence 25p or £0·25 or $£\frac{25}{100}$ will soon be established. But they will need to use tenths before hundreds and here equivalence in measurement will supply examples,

e.g. 1 metre 7 decimetres as $1\frac{7}{10}$ metre or 1·7 metres or 3 decimetres 4 centimetres as $3\frac{4}{10}$ dm or 3·4 dm.

Measurement of area will give additional examples in hundredths

e.g. 1 square decimetre 55 square centimetres can be written as 1·55 dm^2 (about the area of an adult's hand).

Later the third place of decimals can be introduced through measurement in grams and in millilitres

e.g. 1 kg 675 g as 1·675 kg
2 litres 25 ml as 2·025 litres.

Children who can perform calculations in the four operations with understanding will not have difficulty when calculations are extended to include decimal quantities (provided the operator is a whole number in multiplication and division). Multiplication by a decimal fraction will need careful development. A few top juniors will meet problems requiring division of decimals, e.g. How many records at £1·35 can I buy with £5? How many dress lengths 2·25 metres long can be cut from a 22 metre roll? for which they will devise their own methods if they have complete understanding of the problem.

The introduction of the second place of decimals can be made through weather observations. In official records and newspaper reports rainfall and the number of hours of sunshine are normally quoted to two decimal places. Again, provided the children understand what they are doing, the transition from one to two places is made without difficulty. There is no point in extending the use of decimals beyond those experienced by the children unless they happen to come across these (as in using the micrometer to measure the thickness of very thin things such as a sheet of paper or a hair). If a child is able to discover what the graduations on a micrometer mean, and how to use it without being told, there is no reason why the micrometer should not be used in this way. On the other hand there is no reason why it should be introduced unless it is needed.

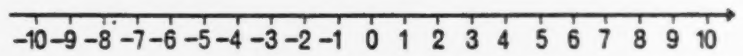


Fig. 4.14

3. DIRECTED AND NEGATIVE NUMBERS

The next extension in the field of number which some children experience is obtained by extending the positive number line through zero to include the negative numbers. If they are already familiar with the number line (the positive numbers set out in order) the extension backwards (to the left) is not difficult. (Fig. 4.14). As will be seen in the section on graphical representation the suggestion to extend the field of numbers backwards sometimes comes from the children themselves. The questions they asked (after they had realised that the positive numbers seemed to go on for ever) were 'What about the other way? Do the numbers stop at zero?' The teacher replied, 'Can you count backwards? If so, continue the line'.

Raised signs e.g. $^{-5}$, $^{+3}$ used to mark points on a number line, have been found very helpful in the early stages of teaching directed numbers to distinguish between the position on the line and the operations of addition and subtraction.

V. Applications of extensions of ideas of number

PERCENTAGES

A small unit is chosen, % or $\frac{1}{100}$, so that 1 is 100 of these units, (100%), 2 is 200 of these units (200%), $\frac{1}{2}$ is 50 of these units (50%) and so on.

Nine-year-olds and ten-year-olds, who have become aware of the mathematical possibilities of the environment, will soon come across percentages in their shopping expeditions (real and imaginary). A group of ten-year-olds in a rural school first encountered percentages when they were studying the germination of wild flower seeds. They were given packets of wild flower seeds containing different numbers according to the type of seed. They planted all the seeds and wanted to find out which gave the best return. At first they tried to solve this problem by expressing the number of seedlings grown as a fraction of the number of seeds planted but this was too complicated. They then began to turn these fractions to decimals and at this stage the teacher told them about percentages.

Another group of ten-year-olds discovered references to percentages in the Saturday shopping page in a newspaper. Once they had discovered what a percentage was they used this knowledge in the books of problems they prepared for each other.

VI. A new look at numbers: sets

An increasing number of teachers may feel that they want to introduce the notion of sets to junior children. The difference between the mathematics of sets and traditional mathematics is largely one of vocabulary and new symbols. Those interested will find a brief section on this topic in Appendix 4.

In this chapter an attempt has been made to indicate the place which the knowledge of number relationships on the one hand and computational practice on the other hand should take in primary school mathematics. It has been emphasised that children can make their own discoveries of number relationships, of quantity relationships and of the operations, through their own first-hand experience with the real materials of their environment (supplemented by structual materials, home-made or commercial). This way of learning is sound and conforms to the latest research on children's learning but it is, of necessity, apparently slower in the early stages when measured by traditional computational achievement alone. By the age of nine years, however, (and by eight for some children) those children who have learnt by their own discoveries are able to hold their own in traditional computational processes also. And there can be no comparison where ability to solve problems (with real materials or from a textbook) is concerned. Children brought up to make their own discoveries in mathematics have complete confidence in their own abilities and show an evident enjoyment and appreciation of mathematics, even when it begins to become, as it must, more abstract. They, like Archimedes, can use their imagination in problem solving when materials are not available or when they no longer need these. (Archimedes said, 'When I have a problem to solve, in imagination I weigh and measure . . .')

There is another advantage which this method of learning brings. Those teachers who have already organised the work so that the children learn by their own efforts all bear testimony to the decrease in the amount of computational practice children require in order to attain and maintain computational efficiency. Many teachers have found that they can safely reduce this practice to two periods (and some to one) each week and that the children's efficiency in computation has improved and not declined in consequence. With this in mind, the suggestion that other aspects of mathematics be included in the primary school programme becomes a reasonable one, and we shall turn our attention to recent developments in this field in the next chapter.

The present chapter has been chiefly concerned with number and quantity relationships of all kinds. The infiltration of ideas from modern mathematics has caused us to take a new look at the underlying structure of our own number system.

Here is a summary, in more mathematical form, of the various relationships which should be explicit to the child from his discoveries. It cannot be over-emphasised that these will become explicit only as a result of discussion between the teacher and children and as a result of real experience and subsequent recording. (The reader would be well advised to test the validity of each of these statements, using numbers instead of letters.)

VII. Summary of the laws of arithmetic

1 THE COMMUTATIVE LAWS OF ADDITION AND MULTIPLICATION

$A + B = B + A$
$A \times B = B \times A.$

(Does this apply to subtraction and division? Consider $A - B$ and $B - A$
and $A \div B$ and $B \div A$.)

2 THE ASSOCIATIVE LAWS OF ADDITION AND MULTIPLICATION

$A + (B + C) = (A + B) + C$
$A \times (B \times C) = (A \times B) \times C.$

3 THE DISTRIBUTIVE LAW OF MULTIPLICATION

$A \times (B + C) = AB + AC$
For example, we work 16×17 as $16 \times (10 + 7)$
$= 16 \times 10 + 16 \times 7.$

4 SUBTRACTION IS RELATED TO ADDITION

$A + B = C, A = C - B, B = C - A.$

5 DIVISION IS RELATED TO MULTIPLICATION

(Does this make sense of $\frac{3}{4} \div \frac{5}{7} = \frac{3}{4} \times \frac{7}{5}$?)
$AB = C; C \div A = B, C \div B = A.$

6 THE ZERO ELEMENT

$A + 0 = A$
The number is unaltered by the addition of zero.

Notice also $(+A) + (-A) = 0$
i.e. $(-A)$ is the additive inverse of $(+A)$.

7 THE UNITY ELEMENT

$A \times 1 = A$
The number is unaltered by multiplication by unity.

Notice also $A \times \frac{1}{A} = 1$ i.e. $\frac{1}{A}$ is the multiplicative inverse of A.

Wandering Outside

More exercises for observing the ordinary. Outside this time. But first, find some comfortable place at home so you can wander just with your head.

Here are three possible exercises. They're all geared to giving you another look at what you usually see. Read them through. Then pick one to try on your first real trip out.

Exercise No. 1: Taking In the Usual

These are questions about things you might see on any walk or bike ride. Try to answer them first. Then check as many as you can out in the world.

On traffic lights, which color is on top?
Does a stop sign have six sides or eight?
Is there a street sign at every corner of an intersection?
If not, how many are there, usually?
Do the numbers on the houses on your street go by two's, or four's, or what?
Is there a public telephone near your house?
On which side of it is the coin return slot?
Are there telephone poles on your block? How many?

Exercise No. 2: A Color Walk

Imagine a walk you've taken lots of times. Like to school, or to a friend's house, or to the store.

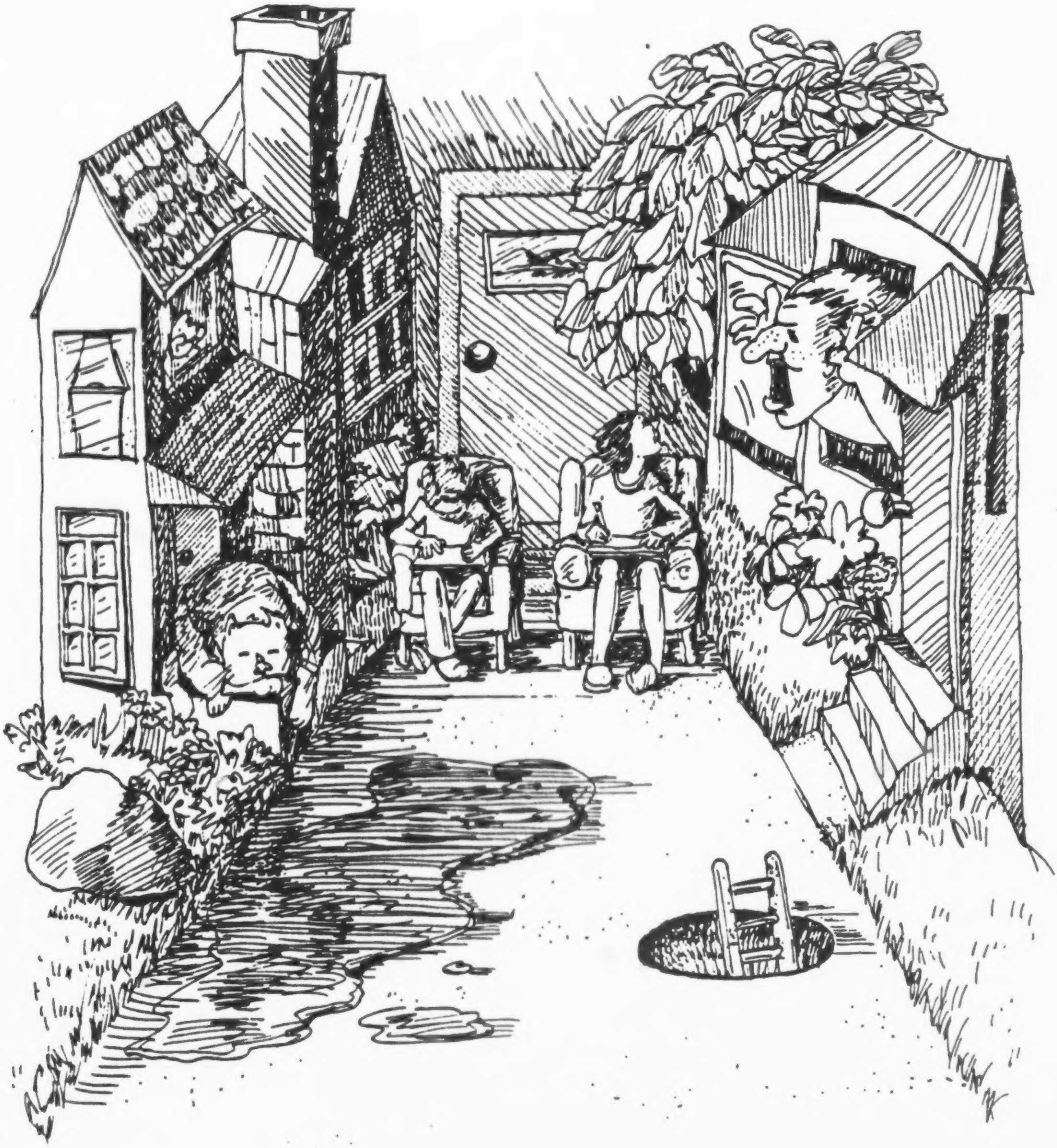
Now, choose a color. Make a list of all the things you usually see on that walk which are the color you've chosen. Then check out your list.

Exercise No. 3: A Friendly Block

This one is good to do with a friend. Think of a block you both walk down often. A block you both feel familiar with. Each of you makes your own list of all the stores and buildings on that block. Include trees too, and telephone poles, and whatever else you can think of. Exchange lists. Then take the walk and check each other.

Did you both list the same things?

The trick is — don't ignore what's out there. Okay, out the front door. (Did it open in or out?)



Looking at What You Usually See

What else has your brain been ignoring lately?

Think of the telephone dial. (Don't look at one yet.) Imagine which letters go where. There are ten holes. There are twenty-six letters in the alphabet. You've seen that dial lots of times. Okay, which letters of the alphabet aren't on the dial? (Long division isn't much help, either.) Make a sketch of the dial. Put in the numbers, too. Then check it.

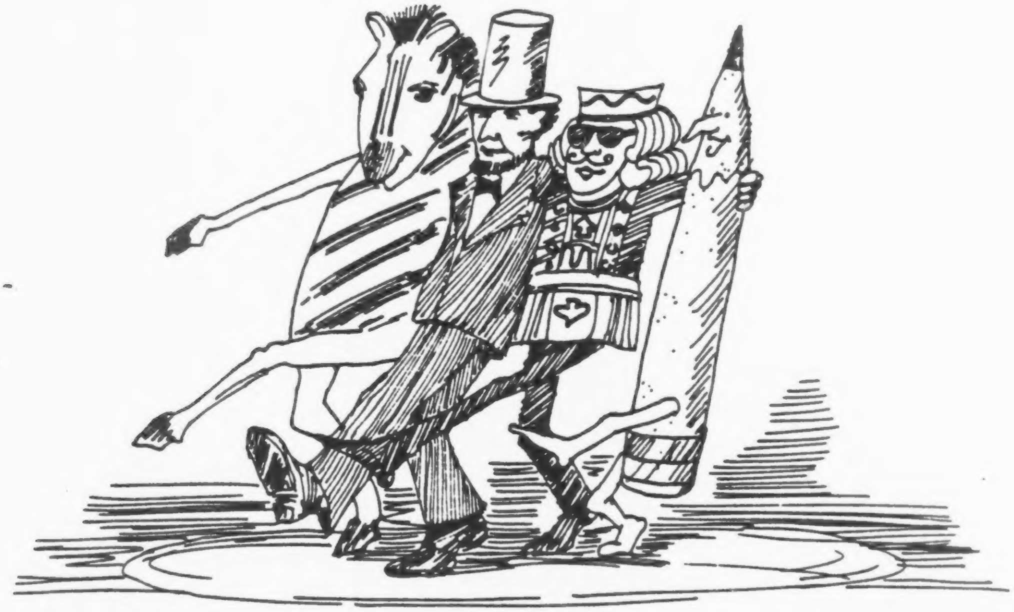
There just isn't room inside your head to store all the information you get. You might think of your brain as a sponge. It will only hold so much. Enough is enough. Besides, you don't really need to remember where the numbers and letters are on the telephone dial. They're in the right place when you need them.

Keeping details in your head isn't always a good idea. Learning to look is. Noticing is good exercise: it helps you see things you've been ignoring all this time.

Try this quiz. Answer true or false. See how you score.

1. The Statue of Liberty uses her right hand to hold the torch.
2. A record on a record player turns in a clockwise direction.
3. Lincoln's head on a penny faces left.
4. Your bedroom door opens in toward your bedroom.
5. The buttonholes on a man's shirt point up and down.
6. Page fifty-two of this book is a right-hand page.
7. The jack of spades is a one-eyed jack.
8. The stripes on a zebra's legs are horizontal.
9. The person who illustrated this book is a woman.
10. Most pencils have eight sides.

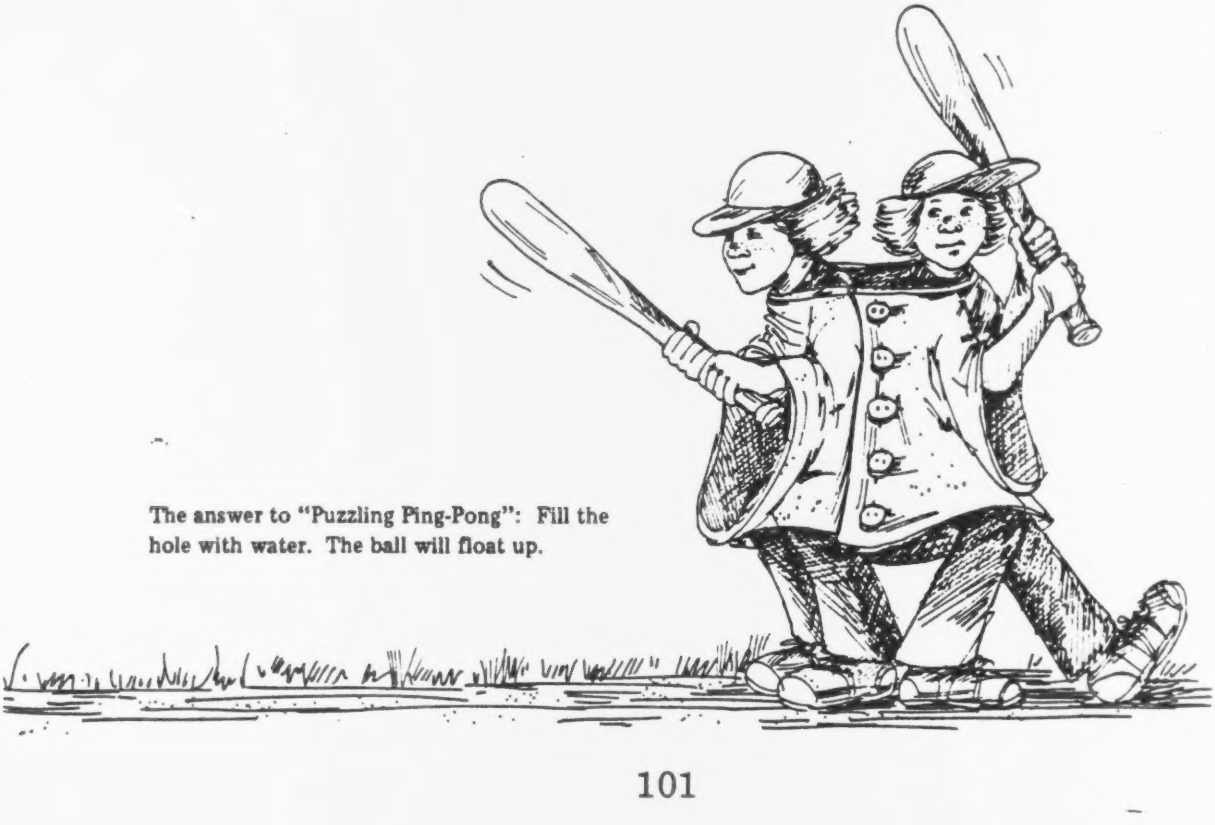
Which were you absolutely sure about? Which did you have to guess? Wait a few days or a week and try the quiz again. See which information you kept stored in your head.



You Only Get Three

This is an "imagine" exercise. You are a TV interviewer. On your program, different people come to be interviewed. You want to learn as much about each person as possible. You have time to ask only three questions. What three questions would you ask for each of these people?

A kid your age who has an identical twin.
A teacher who has just received the award for Teacher of the Year.
A person who has just won a million dollars in a contest.
A person who won a million dollars in a contest a year ago.
A famous athlete who was forced to stop playing because of a broken leg.



The answer to "Puzzling Ping-Pong": Fill the hole with water. The ball will float up.

Letting Your Mind Run Wild

There are times when thinking crazy on purpose is a good idea. Not acting crazy, thinking crazy. You can let your mind run wild in different ways. Try these running wild exercises.

Make a list. The topic is: What this world needs is . . . .

See how many possibilities you can think of.

Lots of things might have been invented just that way. Who ever thought there could be an oven that could boil water in a cup without the cup getting hot, that could bake a potato in four minutes? Who ever thought there could be a machine small enough to fit in your hand that could do all your arithmetic for you? Someone did. The ideas may have seemed crazy at one time. But they came true. How many things in science fiction stories have come true?

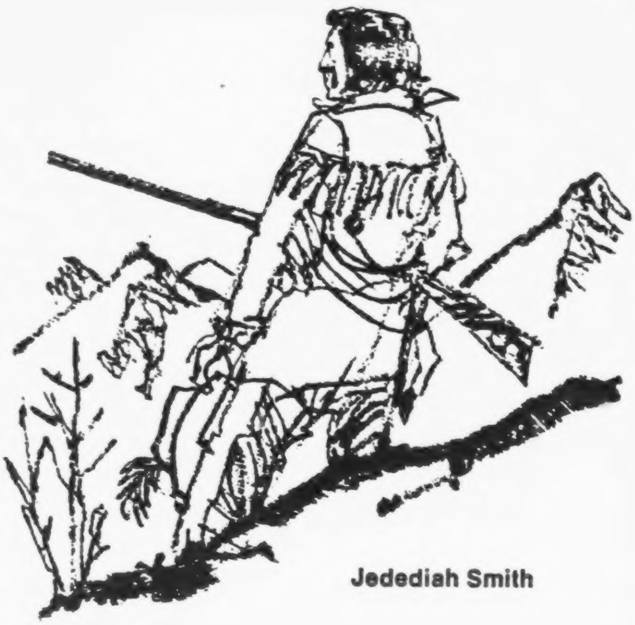
If you like to draw, try these. Draw a solution for each of these problems.

A machine that would automatically make your bed in the morning.
A machine that would help you go to sleep.
A peach picking machine.
A machine that would turn the pages of a book when you're reading in bed and your hands are cold.

Jedediah Plans an Adventure

In 1820 an American explorer, Jedediah Smith, led a band of trappers from Missouri into the Spanish territory called California. The group reached the California territory over a long trail, which went around the rugged, snow-capped Sierra Nevada mountain range. But Jedediah knew that soon other Americans would be coming West and would need a shorter route.

Jedediah decided to be the first man to cross the Sierra Nevada and open a new trail. He knew that it would be a dangerous trip. There would be deep snow and perhaps bitter storms. There would be wild animals to guard against and Indians to be treated with care.



Jedediah Smith

Jedediah planned to take one other man with him, chosen from among his followers. He knew the importance of finding the right man, because success would depend on teamwork. As a start, he thought about the kind of man he needed:

- Whomever Jedediah chose must be *strong* and able to withstand the hardships of the trail.
- Also, he must be *brave*.

10 **Put yourself in Jedediah's place and see if you can think of any other things he should keep in mind when choosing his companion.**

For example, what kinds of special skills might be needed that would aid Jedediah in facing the unknown dangers of the trail? Write your ideas in your notebook.

Jedediah also decided that whomever he chose must have special skills, such as being a good hunter or having experience with Indians and understanding their ways.

Below are pictures and descriptions of the group of followers from which Jedediah will choose his one companion:

Silas Gobel

Short but strong. Has never failed in the face of danger. Lived with Indians once for several years.

John Hanna

Biggest and strongest man in camp. Has a family and wants to return home; not interested in further adventure.

James Reed

Strong as an ox and brave. Plays the banjo well.

Harrison Rogers

Strong, tough as leather, and brave. Good shot with a rifle.

Martin McCoy

Just joined Jedediah's group, so no one knows him. Can't travel far without resting because of a bad limp. Good at reading animal tracks.

Art Black

Proved his bravery once by fighting a bear with only a small knife in order to save his brother's life. Lost a leg in the fight.

11

Eliminate all those men shown above who do *not* fit Jedediah's reasons for being the best man to take along:

First, which of these men are not strong or able enough?

Next go back and drop any men who do not seem to be brave or adventurous enough.

Now eliminate any remaining men who do not have some kind of special skill that would be helpful on the trail.

Finally, write in your notebook the names of any men who are left.

The choice seems to be between Gobel and Rogers. Both are strong, brave, and have special skills. But only *one* man is needed.

12

What should Jedediah do next? Write the letter in your notebook:

a. Find some other reasons for deciding which of the two men would be best to take along.

b. Flip a coin: heads, Gobel; tails, Rogers.

Maybe one man is better for a reason not thought of yet. So next Jedediah compared the two men in other ways:

Gobel is restless if not doing exciting things. Once when he stayed in camp for several weeks, he started a fight because he was bored.

Rogers is the best leader in the group, besides Jedediah. He is hard working, and he is respected by the other men.

Jedediah still could not decide. Until now he had been asking, "Which man would be best to take along?" Suddenly he looked at things in a new way. He turned the problem around and asked, "Which man would be best to leave *behind?*"

13

If you were Jedediah, which man would you leave behind? Tell why in your notebook.

After asking himself which man should be left behind, Jedediah's choice was easy. The camp needed a leader while Jedediah was away, and Harrison Rogers was a good leader. And since Silas Gobel would probably get bored waiting in camp, he would be the best choice to go with Jedediah.

So, on May 20, 1827, Jedediah Smith and Silas Gobel started out to open a new trail. Forty-five days later, they stumbled into a fort on the other side of the Sierra Nevada. They were in rags and were half-starved, but they had made it! And part of the reason for their success was the clever choice Jedediah had made about whom to take with him.

As you can see, choosing the right man for the right job is an important part of productive thinking. Now see if you can find the right man for another, different job.

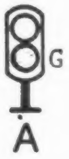
14

Suppose that your country has been invited to a meeting on world peace to create better understanding among nations. You are to pick someone to represent your country at this meeting.

What things should you keep in mind when choosing this person? What kind of person should he be? What special skills are needed? Write your thoughts in your notebook.

Select the right colors to fill in the blanks.

▭
green
1. A and B



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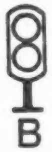
green
2. A and B



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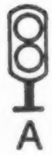
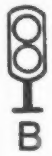
green
3. A and B





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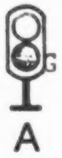
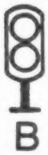
red
4. A and B





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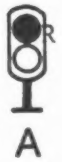
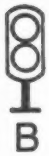
5. A and B





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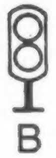

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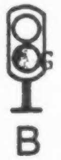

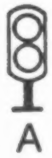

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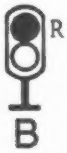
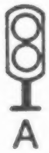
7. A and B





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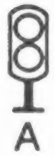

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1230

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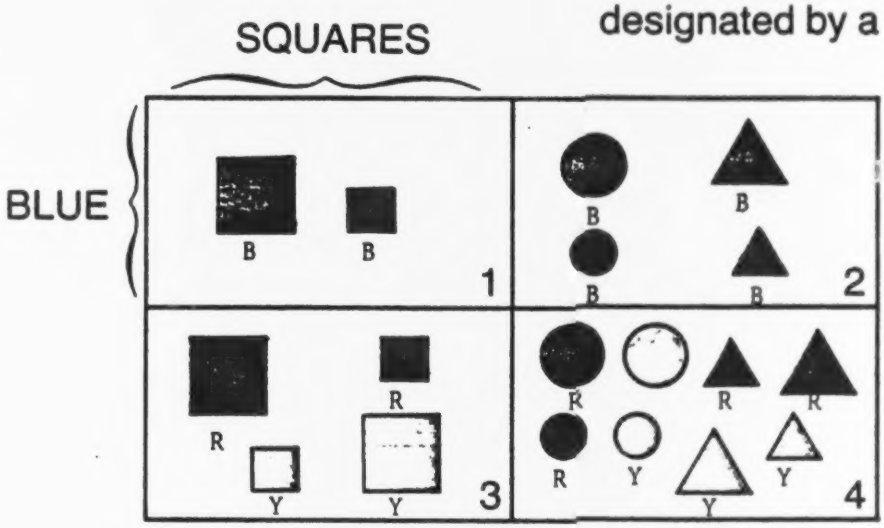

In which field do you find the figures for which these sentences are true?

1. They are blue and they are square ______Field 1______

2. They are not blue and they are not square. __________

3. They are blue and they are not square. __________

4. They are not blue and they are square. __________

5. They are blue and/or they are square. __________

6. They are not blue and/or they are not square. __________

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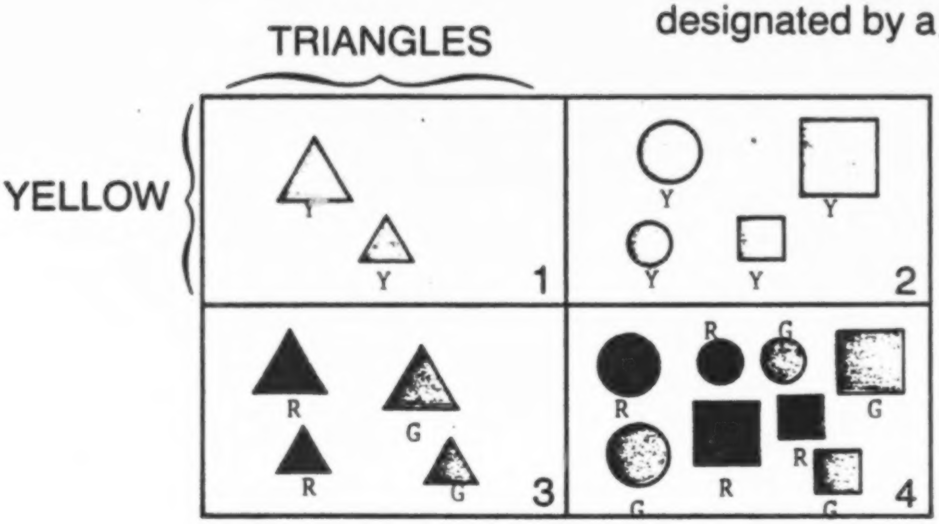
1231

Each of the four fields is designated by a number.



1. In which field do you find the figures for which these sentences are true?

   a. They are not yellow and they are not triangles. ________________

   b. They are not yellow and/or they are not triangles. ________________

2. In which field do you find the figures for which these sentences are not true?

   a. They are yellow and/or they are triangles. ________________

   b. They are yellow and they are triangles. ________________

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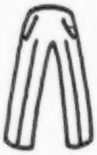
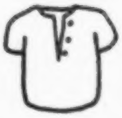
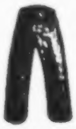
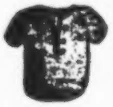
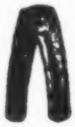
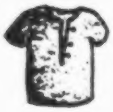
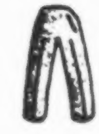
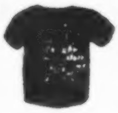
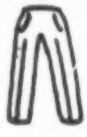
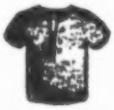
 AND/OR 

Edith, Elizabeth, Emily and Eve are planning a trip. A day before the trip they said to each other:

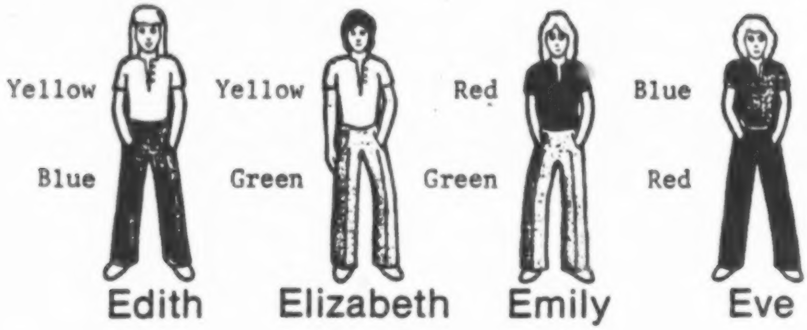
Edith: “I will wear  and/or .”

Elizabeth: “I will wear  and/or .”

Emily: “I will wear  and/or .”

Eve: “I will wear  and/or .”

For the trip they wore:


Yellow
Blue
Edith
Yellow
Green
Elizabeth
Red
Green
Emily
Blue
Red
Eve

Which one of them did not tell the truth the day before?

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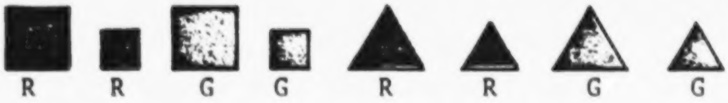
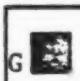
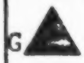
1233



Draw and color in the figures.

	IT IS NOT BIG	IT IS NOT RED	IT IS NOT A TRIANGLE
	true	true	true
	true	true	false
	false	true	false
	false	false	true
	false	true	true
	true	false	false
	false	false	false
	true	false	true

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1234

A fun way to introduce probability

RICK BILLSTEIN

An assistant professor in the department of mathematics at the University of Montana in Missoula, Rick Billstein is involved in elementary school teacher training at the university. This article is a result of some work in probability, which the university requires of all prospective elementary school teachers.

The typical introduction to probability usually involves tossing a single coin. The students and teacher will soon agree that this is a trivial activity. The possible outcomes of the experiment are a head, H, or a tail, T. The outcome set could simply be listed as {H, T}. If the coin were tossed a large number of times, the proportion of heads appearing should approach 1/2. For this reason we assign to each outcome the probability 1/2. We also say that the two outcomes are *equally likely* and the coin is *fair*. Figure 1 illustrates another way of describing one toss of a fair coin. This description will hereafter be referred to as a *tree diagram*. Each branch corresponds to an element in the outcome set with its appropriate probability labeled on the branch. Also notice that the sum of the probabilities of all the outcomes in the set is equal to 1.

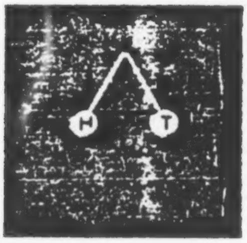


Fig. 1

Suppose a coin is tossed twice. The possible outcomes of the experiment are a head followed by a head, HH; a tail followed by a tail, TT; a head followed by a tail, HT; or a tail followed by a head, TH. Most students will have very little trouble listing these possible outcomes in a set, {HH, HT, TH, TT}. After much experimenting and discussion, the students will notice that the probability 1/4 can be assigned to each of these outcomes. Figure 2 shows a tree diagram of the experiment.

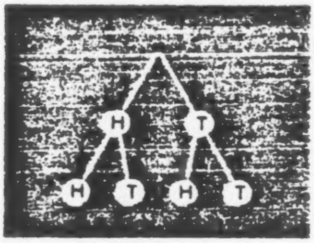


Fig. 2

Notice that the probability assignment to each element in the outcome set is simply the product of all probabilities along the branches of the path. For example the probability of HH is 1/2 × 1/2, or 1/4. The author will not attempt to motivate this idea any further but simply state that the probability of any path is equal to the product of all probabilities along the branches of the path.

With this background the students are ready for a new coin game. Let the students choose one of the four equally likely outcomes listed from tossing the coin twice. The teacher then chooses a different outcome. The coin is flipped until either the

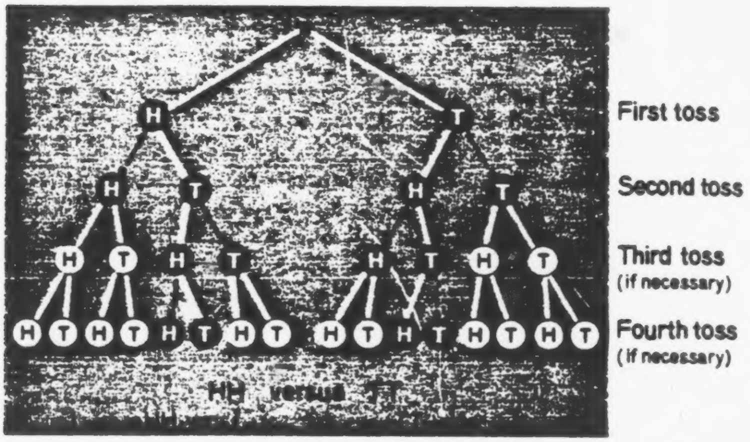

First toss
Second toss
Third toss
(if necessary)
Fourth toss
(if necessary)
HH versus TT

Fig. 3

students' choice or the teacher's choice appears. Suppose, for example, that the students choose TT and the teacher chooses HT. If the first two flips show TH, no one has won and the game continues. If after six flips, the string THHH*HT* is obtained, the teacher is declared the winner since the sequence HT finally appeared. Suppose the students choose HT and the teacher chooses TH. If the first two tosses show HH, no one has won and the game continues. If after three flips the sequence H*HT* appears, the students win because their choice, HT, has appeared in the sequence.

To develop a strategy for playing this game we might first examine the choices HH versus TT. If we refer to the tree diagram (fig. 3) and use a simple argument involving symmetry, it is easy to convince students that this is a fair game. A win is possible on every toss for both players.

Now consider HH versus TH. This at first glance also appears to be a fair game. However, observe the tree diagram (fig. 4) for this case. On the second toss, notice that the teacher's, TH, and the students', HH, outcomes each appear exactly once. At this point students may still feel that this is a fair game. Careful analysis will now show that if three or more tosses are necessary, the students' choice, HH, will never appear. Since the students' probability of winning

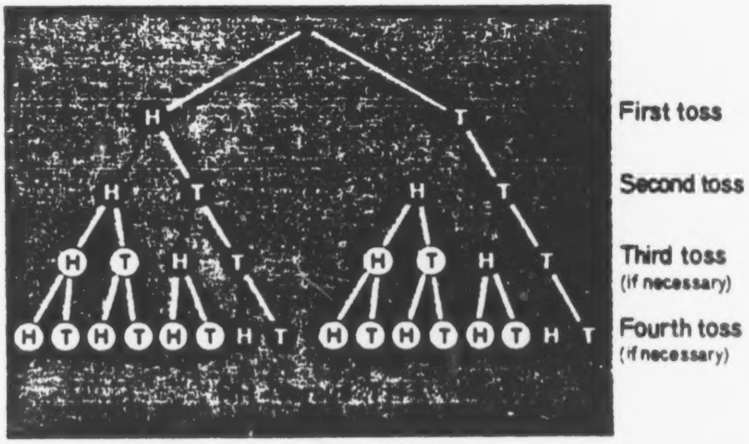

First toss
Second toss
Third toss
(if necessary)
Fourth toss
(if necessary)

Fig. 4

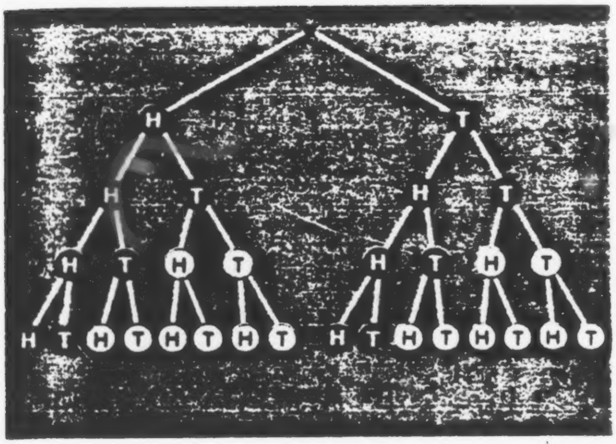


Fig. 5

has now been shown to be 1/4, and since the sum of the probabilities must be one, the teacher's probability of winning must be 3/4. Hence the game is no longer considered fair. A similar argument holds if the students' first choice is TT and the teacher's choice is HT. (Fig. 5)

The probabilities of the teacher's winning the game are summarized in the table in figure 6. Of the twelve possible games, only eight are fair in the sense that both choices are equally likely.

Teacher's choice (second)

Students' choice (first)	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	–	.50	.75	.50
[illegible]	.50	–	.50	.25
[illegible]	.25	.50	–	.50
[illegible]	.50	.75	.50	–

Fig. 6

After the details of the game involving two coins are understood by all the students, the better students might be encouraged to investigate the corresponding game involving three flips of a coin. If a coin is flipped three times there are eight equally likely outcomes—HHH, HHT, HTH, HTT, THH, THT, TTH, and TTT. If, for example, the first choice is HHT, is there a second choice that has probability greater than 1/2 of winning? Is there a second choice that will make this a fair game? Is there a second choice that has the best chance of winning? The interested reader may find this game discussed in the Winter 1973 issue of *The Two-Year College Mathematics Journal* (Craswell).

A second game that may be used in the same way is a game called "Win" (Smith 1973). This game is played with the nonstandard dice as shown in figure 7. The students again will be given first choice of any one of the four dice. The teacher then chooses one of the remaining dice. The two selected dice are then rolled at the same time. The player with the higher number is the winner.

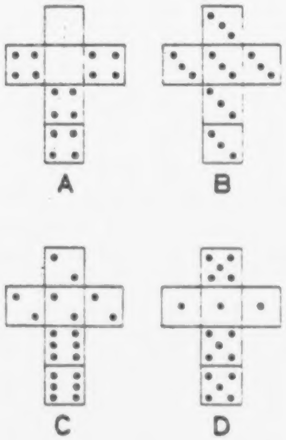


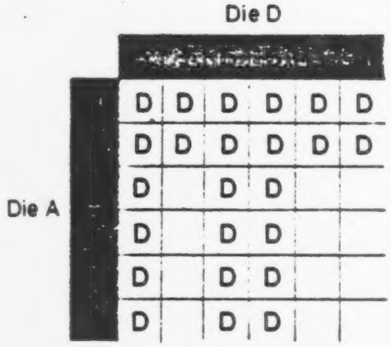
Fig. 7

This again is a surprising game. Suppose the students choose A and the teacher chooses D. Figure 8 shows that the teacher would win 24 out of 36 possible rolls for the two dice. As you will soon discover, no matter what choice the student makes first, the teacher may always make another choice that has probability 2/3 of winning:

Students' choice (first)	Teacher's choice (second)
A	D
B	A
C	B
D	C

These results can be substantiated by examining the outcome sets for each case.

Probability can be a fascinating study for elementary students. It can be a subject of interest to the better students as well as to the slower students because the problems can be identified with games, models, or real-life situations. There are many problems where intuition can be stressed and there are also many cases such as those given in this article where intuition fails and a careful analysis is required. In the words of Freudenthal (1970), "probability applies in every day situations, in games, in data processing, in insurance, in economics, in natural sciences. There is no part of mathematics that is as universally applied, except, of course, elementary arithmentic."



D	D	D	D	D	D
D	D	D	D	D	D
D		D	D		
D		D	D		
D		D	D		
D		D	D		

Fig. 8

References

Craswell, Keith J. "An Interesting Penny Game." *The Two-Year College Mathematics Journal* 4(1973):18-25.

Freudenthal, Hans. *The Aims of Teaching Probability*. Stockholm: Almquist and Wiksell Vorlog AB, 1970.

Smith, Karl J. *The Nature of Modern Mathematics*. Monterey, Calif.: Brooks/Cole Co., 1973.

Probability with marbles and a juice container

JAMES E. HIGGINS

An assistant professor of elementary education at Indiana State University in Terre Haute, James E. Higgins teaches undergraduate courses in methods of teaching elementary mathematics and also supervises student teachers.

Probability is too often omitted from the elementary mathematics curriculum. Recent experiences using probability with elementary students, both primary and intermediate, indicate that such a topic increases mathematical understanding and teaches mathematical thinking—two worthy goals of a modern curriculum. Here is an activity that fifth- and sixth-grade students enjoy.

Out of sight of the students, the teacher places marbles of different colors in an opaque juice container that has a pour spout through which one marble at a time can pass. The students are given no prior information concerning the number or colors of the marbles. The container is shaken, and one marble is withdrawn. The color of the marble is recorded by the students, and the marble is again placed in the container. This process is repeated a number of times. (About twice as many drawings as there are marbles is satisfactory, but one never knows for sure. Since the activity is not foolproof, there is no way to guarantee that a certain color of marble will appear the expected number of times.)

The tabulations for twenty drawings are shown in table 1. After the drawings and tabulating have been completed, the teacher discloses the number of marbles in the container and asks the students to speculate as to how many marbles there are of each particular color. If the students are told there are 10 marbles in the container, then a logical estimate for them to make, on the basis of the data in table 1, is 6 blue, 3 green, and 1 yellow. Assume that the estimate is correct. A discussion of the expectations is now in order, leading to the understanding that the expected ratio of colors is 12:6:2 (out of twenty drawings).

However, with the tabulations in table 1, the result *could* have been 6 blue, 2 green, 1 yellow, and 1 red, even though a red marble failed to appear in the drawings. Such an occurrence is unlikely, although it may happen. This possibility will automatically lead to further discussion, with possible allegations made to the teacher's

[*Continued on page 108*]

Blueprint for Ratio and Scale

[*Continued from page 77*]

Once the measurements had been checked, children were given larger pieces of paper on which to make scale drawings of their apartments. The children made their own scales by finding a relationship between the outside dimensions of the apartment and the size of the paper (see fig. 2). They checked the ratio of line segments to room dimensions each time they drew a room, to verify that they were using the right lengths. A protractor or the corner of a sheet of paper was used to make corners square. Parallel lines also were used in this lesson. When the floor plans were complete, the children drew furniture to scale to complete their plans.

Example

Outside measurement
46' × 54'

Paper size
12" × 18"

$\frac{12}{46} \approx \frac{1}{4}$, $\frac{18}{54} = \frac{1}{3}$

$\begin{array}{r} 11\frac{1}{2} \\ 4\overline{)46} \end{array}$ this will fit

$\begin{array}{r} 18 \\ 3\overline{)54} \end{array}$ this will fit but leave no border

$\begin{array}{r} 15 \\ 3\overline{)46} \end{array}$ this will not fit

So a scale of 1" = 4' will permit a scale drawing of a 46' × 54' apartment to fit on 12" × 18" paper, and still leave a small border

Fig. 2

Some children went on to design homes of one or two levels, and others went to the library to do research on blueprints and architecture. One child even planned an excellent circular home. This practical use of ratios, fractions, and scales held the interest of the children so well that they were reluctant to bring each class session to a close.

Probability with Marbles

[*Continued from page 97*]

Table 1
Record for twenty drawings

Color of Marble	*Number of times it appeared*
Blue	13
Green	6
Yellow	1

"sleight of hand," as well as more worthwhile explanations.

Any number of different colors of marbles (10 marbles in all) may be used. Students find the expected results most of the time. The more colors used, the greater the students appear to enjoy the exercise.

Four results of the activity are readily apparent:

1. The students gain a deeper understanding of the meaning of probability;
2. Certain concepts of ratios are strengthened (14:20 = 7:10);
3. A realization that things are not always as they appear develops;
4. The activity is fun.

Discoveries in geometry by folding and cutting

RONALD R. EDWARDS

An associate professor of mathematics at Westfield State College in Westfield, Massachusetts, Ronald Edwards teaches both undergraduate and graduate courses in mathematics and mathematics education. He also serves as coordinator of graduate programs in mathematics education at the college.

Most elementary students have had some experiences in paper folding—either with origami or such simple activities as folding a sheet of paper in quarters or constructing a paper airplane. Also, by cutting and folding, students may have constructed cubes, open boxes, snowflakes, or chains for Christmas trees. Students show interest in such activities and the following series of simple folding and constructing activities may prove both pleasurable and mathematically rewarding. Through these activities, relationships of geometric shapes and regions may be examined; definitions in geometry, reviewed; statements of geometric theorems, visualized; and students' creative talents, exercised.

MAKING AND FOLDING THE TRIANGLE

Begin with a sheet of colored construction paper (about 23 cm by 30 cm). Fold corner *A* so that edge *DA* lies along edge *DC* (fig. 1) and crease the paper sharply at this fold. Opening the paper again, fold corner *C* so that edge *BC* lies along edge *BA*. Again, crease the fold and open the paper. Tearing or cutting along the creases *DE* and *BF* (fig. 2) produces two isosceles, right-triangle shapes and one parallelogram shape.

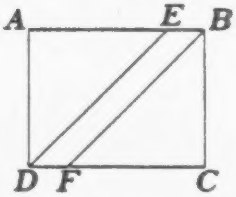


Fig. 2

Using one of the triangular shapes, make the series of folds indicated in figure 3, creasing the paper sharply for each fold. Note that each fold divides a triangular region in half. The completed folds separate the original triangular region into eight congruent triangular regions.

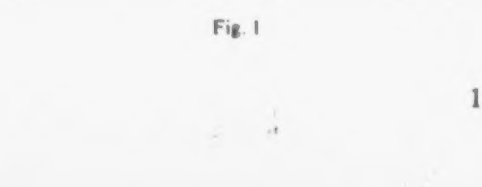


Fig. 1

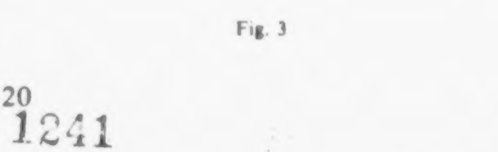


Fig. 3

SOME FOLDING ACTIVITIES

Fold your triangular region along the creases so that a region of each of the following shapes is formed:

1. a square
2. another square (either larger or smaller than the first)
3. a rectangle (that is not a square)
4. a triangle whose area is 1/2 that of the original region; 1/4 that of the original region; 1/8 that of the original region
5. a parallelogram (that is not a rectangle)
6. a trapezoid
7. another, different trapezoid

SOME GEOMETRIC THEOREMS

Place your triangle so that it is positioned as shown in figure 4. Note that *the longest side of the triangle is opposite the angle of largest measure.* In a right triangle, the side opposite the right angle (the largest angle) is called the hypotenuse.

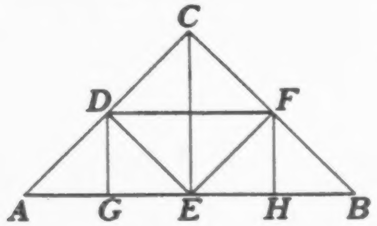


Fig. 4

Fold your triangle so point B lies on point E, point A lies on E, and point C lies on E as in figure 5. Note that *the sum of the measures of the interior angles of the triangle is 180 degrees.*

Fold your triangle so point B lies on point A. Segment CE is the altitude to side AB and $\angle A \cong \angle B$. Note that *the altitude from the vertex angle of an isosceles triangle divides the base into two congruent segments* and *the sides opposite the congruent angles of an isosceles triangle are congruent.*

Fold your triangle so that point A lies on point C and point B lies on point C. Segments CE, AE, and BE are the same length. Note that *the midpoint of the hypotenuse of a right triangle is equidistant from the three vertices of the triangle.*

These are examples of theorems that can be visualized using your folded triangular regions.

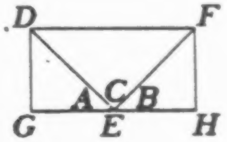


Fig. 5

SOME CONTRUCTION ACTIVITIES

Cut your triangular region along the folds, giving you eight congruent, triangular regions. In the following activities you will use these small triangular regions to build more complex regions. However, the triangles must be joined in one of the three ways indicated in figure 6.

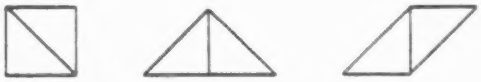


Fig. 6

1. Exchange four small triangular regions with someone else, giving you four of one color and four of another. Form patterns of the type illustrated in figure 7.
2. Using eight triangles, form a rectangle that is not a square.
3. Form another, different rectangle.
4. Using six triangles, form a hexagon.
5. Experiment with forming other shapes.

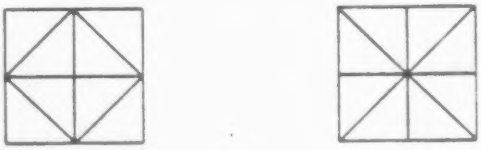


Fig. 7

FURTHER INVESTIGATIONS

Using two of the small triangular regions, there are only three different geometric shapes that can be formed (fig. 6)—a square, a triangle, and a parallelogram.

Others may look different, but they are merely rotations or reflections of these three.

1. How many geometric shapes can be formed by joining three triangular regions?
2. Four triangular regions?
3. Five triangular regions?
4. Keep a record of the possible shapes you find in the investigations 1, 2, and 3.

SOME ACTIVITIES WITH THE SCRAPS

Not included in the foregoing activities is the parallelogram shape region, labeled *DFBE* in figure 2. The following are a few activities you may try with these scraps.

1. Without using a pencil, ruler, or compass, fold the parallelogram shape as shown in figure 8, where each triangle that is formed is isosceles and all triangles are congruent to $\triangle ABC$. In $\triangle ABC$, $AB \cong AC$. Cut along fold *HI* and discard the region *HIJK*. Join the ends of *ABHI* so that point *I* lies on point *C*, point *H* lies on point *B*, and point *G* lies on point *A*. Glue or staple these two regions together forming a three-dimensional shape.
2. Make several more of these three-dimensional shapes and try joining them to make three-dimensional structure.
3. From the parallelogram region you can construct a hexaflexagon (Berger 1951, Olson 1975).
4. Using the parallelogram region explore the Möbius strip or paper knots (Johnson 1957, Olson 1975, Richardson 1976).

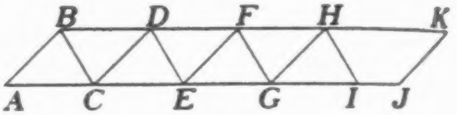


Fig. 8

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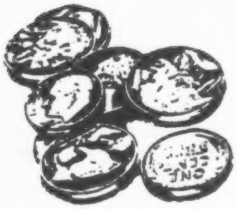
Johnson, Donovan. *Paper Folding for the Mathematics Class.* Reston, Va.: National Council of Teachers of Mathematics, 1951.

Olson, Alton, T. *Mathematics through Paper Folding.* Reston, Va.: National Council of Teachers of Mathematics, 1975.

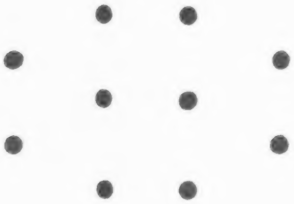
Richardson, Lloyd I. "The Möbius Strip: An Elementary Exercise Providing Hypotheses Formation and Perceptual Proof." *Arithmetic Teacher* 23 (February 1976):127–29.

IDEAS

Name ____________________

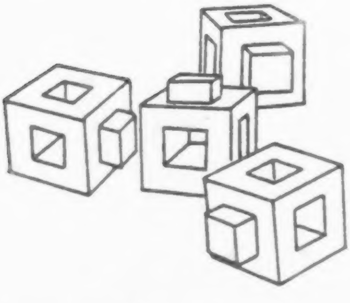


How many different ways can you have 25¢?

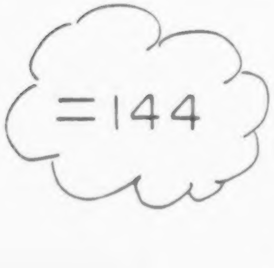


You have 10 points. How many line segments are needed to connect each pair?

How many ways can you fold a piece of paper in half?



How many shapes can you make with 4 cubes?



Write 10 computational exercises that have the answer 144. Use +, −, x, and ÷, at least once in each exercise.

IDEAS

Levels 3 or 4

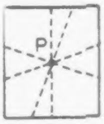
Objective: Experiences in problem solving

Directions for teachers: (all levels)

1. Remove the activity sheet and make a copy of it.
2. Cut the problems apart and paste each one on a 5-by-7 card.
3. Suggestions for use:
   a. Post one as the "Problem of the Week." Post student solutions with next week's problem.
   b. Give one to each team of students. Have teams report their progress or solution.
   c. Give one to an individual as a special challenge or a special project.

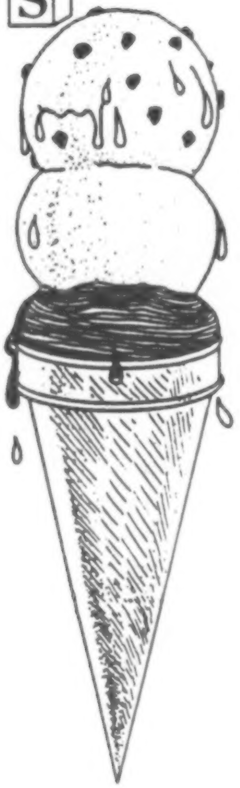
Comments: Be receptive to partial solutions and incomplete reasoning patterns. Encourage students to test their ideas. Open-ended problems such as these often suggest other problems to the perceptive student. Encourage your students to create problems for your file.

—25¢: 8 ways
—10 points: 45 line segments
—Endless number of ways. Any fold through point P.



—4 cubes: 8 shapes
—Examples: $100 \div 2 \times 3 + 10 - 16 = 144$; $75 \div 3 \times 8 - 70 + 14 = 144$

Name ______________________________



How many ways can you arrange the three scoops of ice cream? Draw them.

How many ways can you arrange one scoop? Two scoops?

Complete this table

Scoops	Ways
1	
2	
3	
4	
5	

Can you find a way to figure the pattern? Hint: It helps to multiply.

IDEAS

For Teachers

Levels: 4, 5, 6

Objective: To investigate permutations—an activity in logical thinking

Directions for teachers:

Duplicate a worksheet for each child. The worksheet is self-explanatory, but make sure the children understand the directions.

The solution:

Scoops	Ways
1	1
2	2
3	6
4	24
5	120

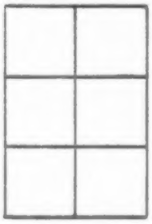
Mathematically, the rule has to do with the concept of "factorial." For example, 3! is read "three factorial" and is the product of the integers from 1 to 3.

$$3! = 3 \times 2 \times 1 = 6$$
$$4! = 4 \times 3 \times 2 \times 1 = 24$$

Name ______________________

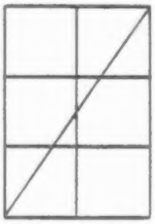
CORNER TO CORNER

If you have a rectangle like this,



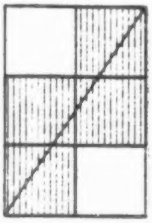
3 by 2

and you draw a diagonal,



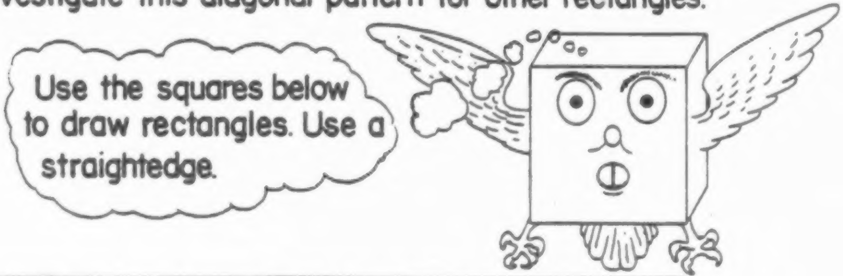
3 by 2

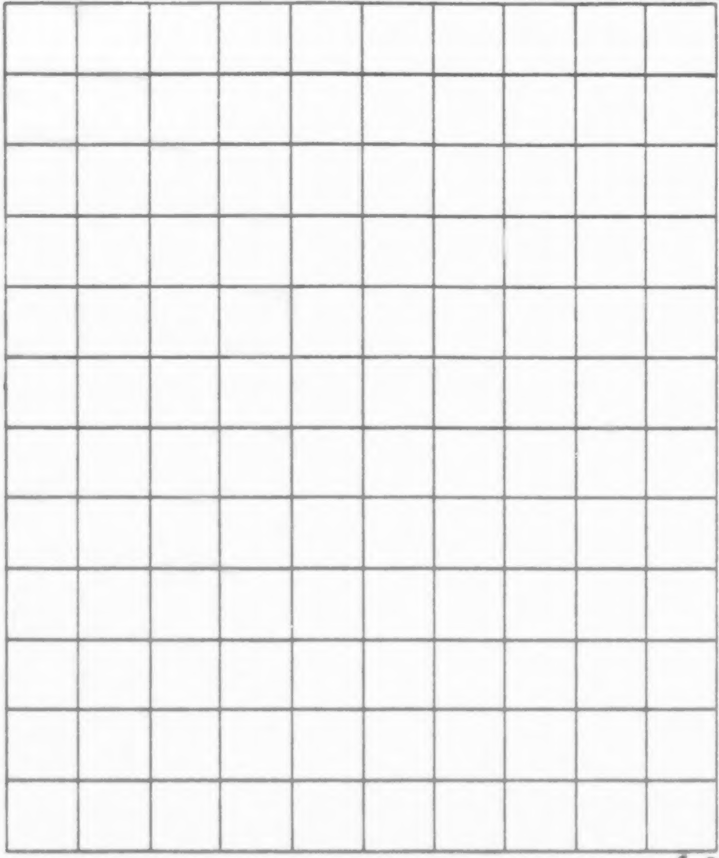
the diagonal goes through 4 squares.



3 by 2

Investigate this diagonal pattern for other rectangles.


Use the squares below to draw rectangles. Use a straightedge.



Dimensions	Squares cut with diagonal

IDEAS

For Teachers

Objective: To investigate number patterns from a geometrical experiment

Levels: 3, 4, 5, 6

Directions for teachers:

1. Duplicate a worksheet for each child.
2. Make sure they understand the directions. It would be helpful to have additional squared paper available.
3. Organizing the data makes it easier to investigate the patterns. One suggestion for doing this is to look at all the rectangles that have one dimension kept the same; for example:

Dimensions	How many?
2 × 1	2
2 × 2	2
2 × 3	4
2 × 4	4
2 × 5	6

You may want to have different groups of students try the experiment keeping a different dimension constant.

IDEAS

Name ______________________________

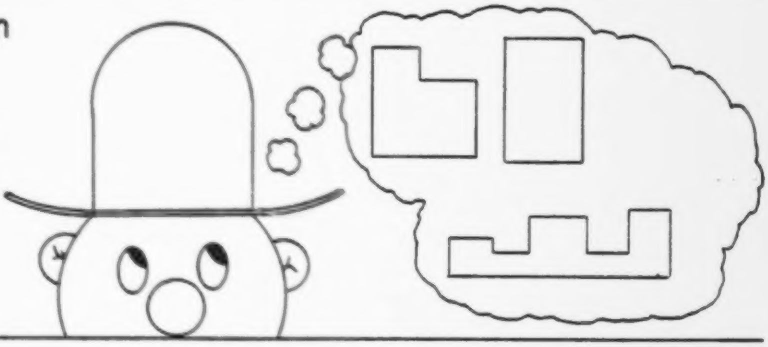
THE IMAGINARY GARDEN AND FENCE PROBLEM

You are planning a garden that will cover 12 squares on the squared paper.

Mathematicians would say:
"The area of the garden
is 12 square centimeters."

You may make the garden any shape you like.

But.... you need to build a fence around it too.



Draw different possible gardens on the squared paper and find which needs the shortest fence and which needs the longest

Mathematicians would say:
Find which shape of 12 sq. cm has the shortest perimeter and which has the longest.

Cut out your results and paste them here.

IDEAS

For Teachers

Objective: To develop the idea of the relationship between perimeter and area of rectangles

Levels: 4, 5, and 6

Directions for teachers:

1. Reproduce a copy of the activity sheet for each student.
2. Provide squared paper.
3. The student directions are self-explanatory.

Going further:

When the students have solved the 12-square problems, ask them to solve problems using 16, 25, or 36 squares.

DESIGNS WITH TESSELLATIONS

April 1974

By Evan M. Maletsky, Montclair State College, Upper Montclair, NJ 07043

Teacher's Guide

Grade level: 7–12

Materials: One set of worksheets and a ruler for each student. A set of transparencies for classroom demonstration and discussion. Several sets of congruent triangles and quadrilaterals.

Objectives: To develop skill in drawing congruent polygons on a rectangular grid. To construct tessellations from various polygons. To show how designs can be created from basic tessellation patterns.

Directions: First show how congruent triangles cut from colored paper can be arranged on the board to cover the surface without overlapping. Use the illustration to define a tessellation. Then show several other examples using different triangles and quadrilaterals. Colored acetate pieces on the overhead projector make a vivid demonstration. Follow this introduction with the worksheets.

TRIANGLES *Sheet 1:* Show how several additional triangles can be formed using the transparency. Then have the students complete the tessellation and draw in the designs suggested.

QUADRILATERALS *Sheet 2:* Again show how several additional quadrilaterals can be formed using the transparency. Stress the importance of careful counting in constructing congruent quadrilaterals on the grid. Students should complete the tessellation with the quadrilateral before drawing in the designs.

Since the sum of the angle measures of a quadrilateral is always 360°, any quadrilateral can be used for a tessellation. Simply have the four different angles meet at a common vertex in the array. Students may illustrate this with variously shaped quadrilaterals on separate sheets of graph paper.

HEXAGONS *Sheet 3:* Illustrate and discuss carefully each of the three figures in step one. Then arrange six cutouts of the flying fish as shown and point out the hexagonal array formed from the six basic equilateral triangles.

With sheet 3 the individual student should extend the tessellation using a tracing or cutout of the original figure.

Supplementary Activities:

1. Ideally, the interested student will want to create some original tessellations on his own. Encourage this interest by posting original student designs and by illustrating other examples of Escher's works.
2. In better classes, discuss the detailed mathematical process of forming tessellations of the Escher type.
3. Students who are unfamiliar with this topic might want to explore the various regular and semiregular tessellations possible. See the references below for details.

REFERENCES

Escher, M. C. *The Graphic Work of M. C. Escher*. New York: Ballantine Books, 1967.
Ranucci, Ernest R. *Tessellation and Dissection*. Portland, Maine: J. Weston Walch, 1970.
Steinhaus, Hugo. *Mathematical Snapshots*. New York: Oxford University Press, 1969.

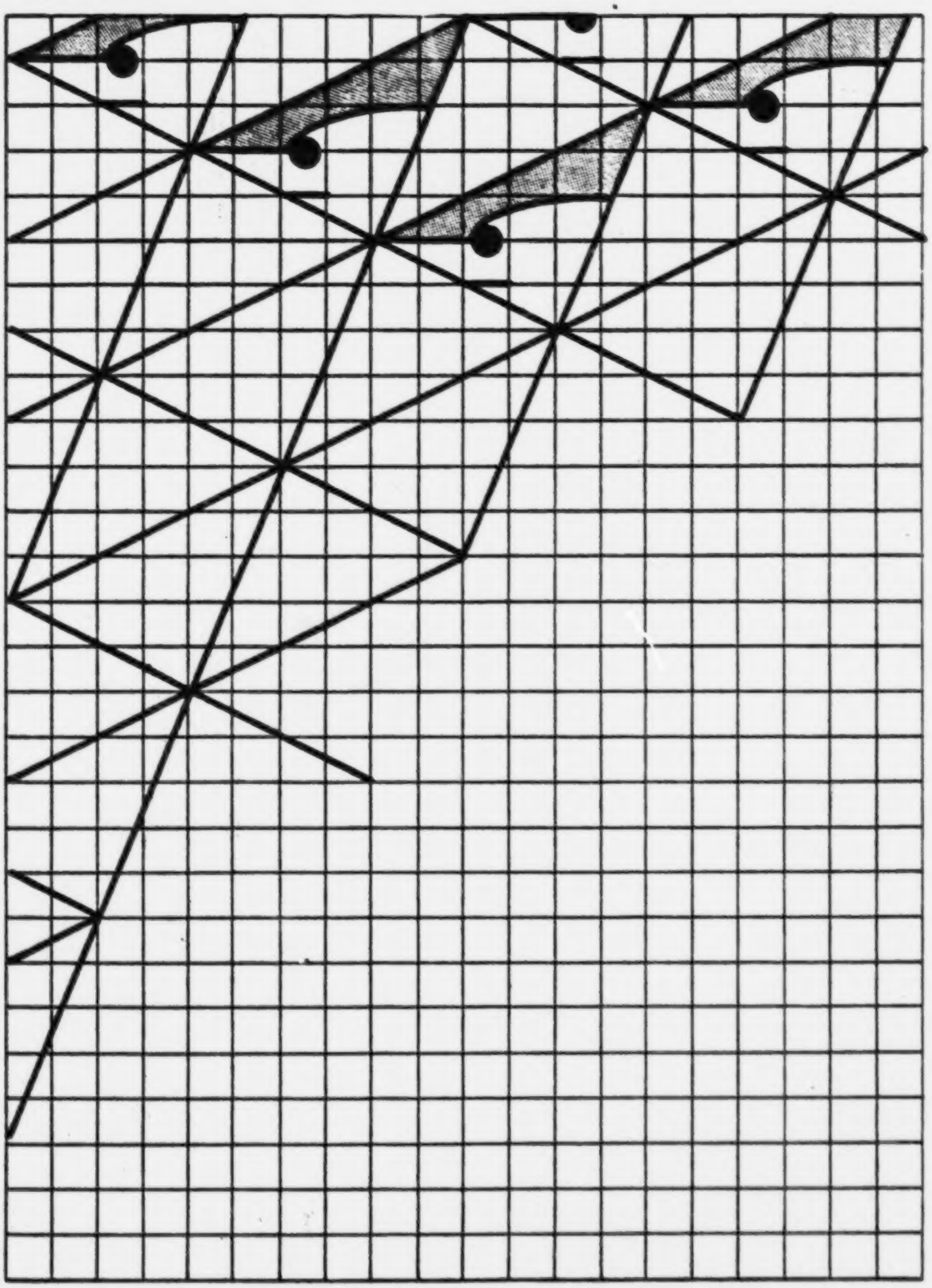
Editorial comment: **The topic of tessellations can be introduced with a discussion of the patterns used in laying tiles on floors or building walls with bricks or blocks. Although equilateral triangles, squares, and rectangles are obvious figures for tessellations, students will be surprised to find that *all* triangles and *all* quadrilaterals, convex and concave, can be used. The suggested extension of this topic to include semiregular tessellations can be both challenging and rewarding and offers an excellent opportunity for students to explore the relationships among various regular polygons. One familiar semiregular tessellation uses regular octagons and squares. In all, eight semiregular tessellations are possible.**

Sheet I TESSELLATING WITH TRIANGLES

Congruent triangles of any shape can be used for a tessellation. They can be placed side by side to cover a surface without any overlapping and without leaving any spaces uncovered.

Step 1: Finish covering the grid with more congruent triangles of the same size. Count squares carefully to see that each new triangle drawn is congruent to those already shown.

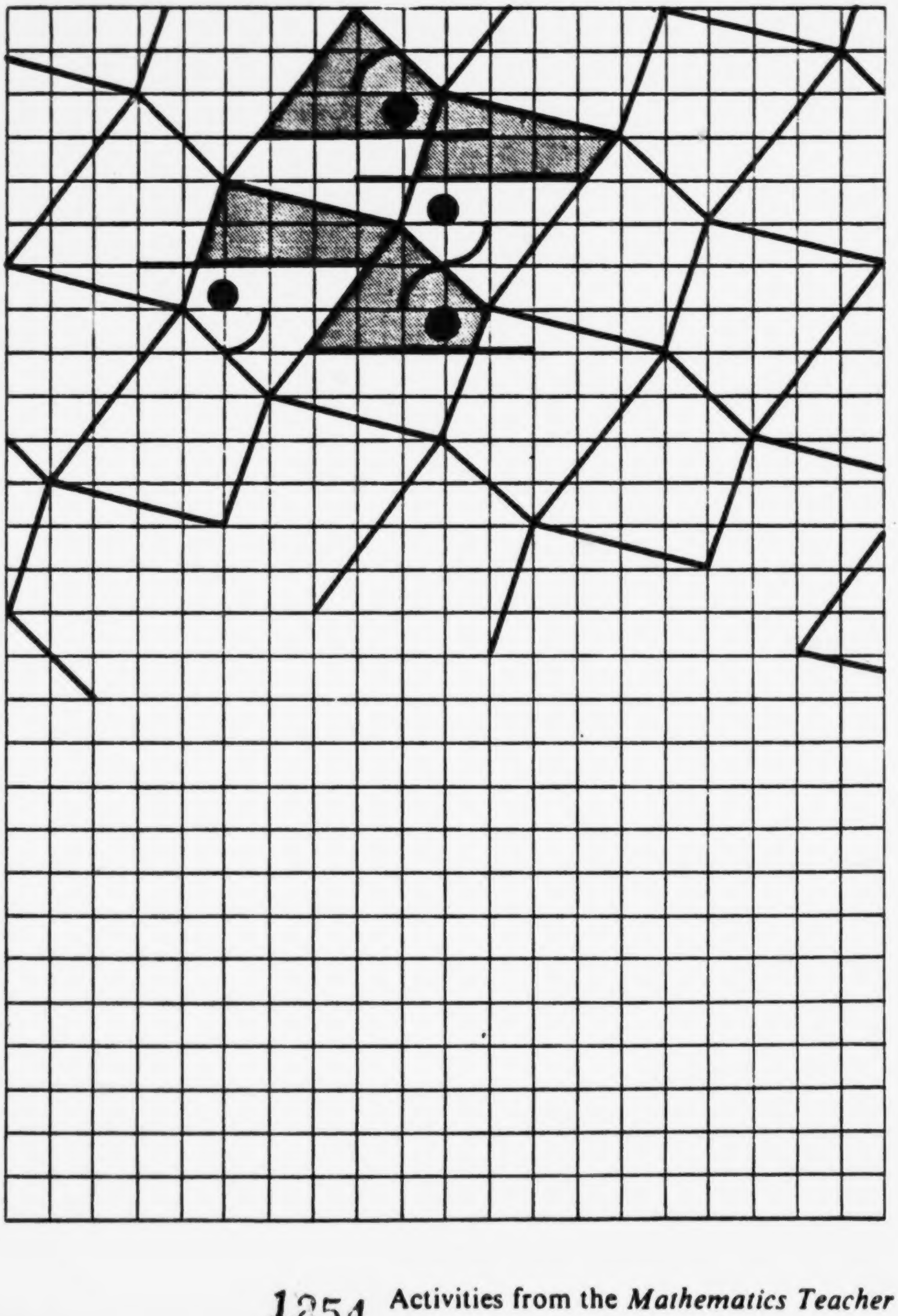
Step 2: Complete the tessellation by drawing the design in alternate triangles as already begun.



Sheet 2 TESSELLATING WITH QUADRILATERALS

Step 1: Finish covering the grid with congruent quadrilaterals. Count squares carefully to see that each new quadrilateral drawn is congruent to those already shown.

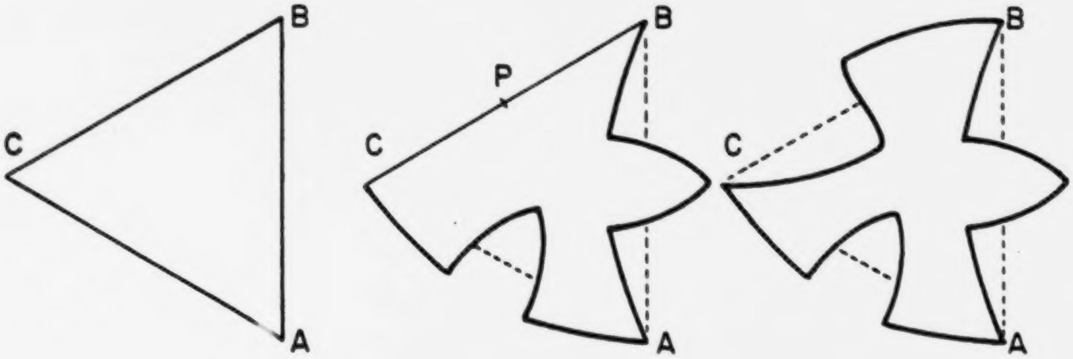
Step 2: Now complete the tessellation by drawing the head in each quadrilateral. Notice that only half will face to the left. The other half will face to the right but be upside down.



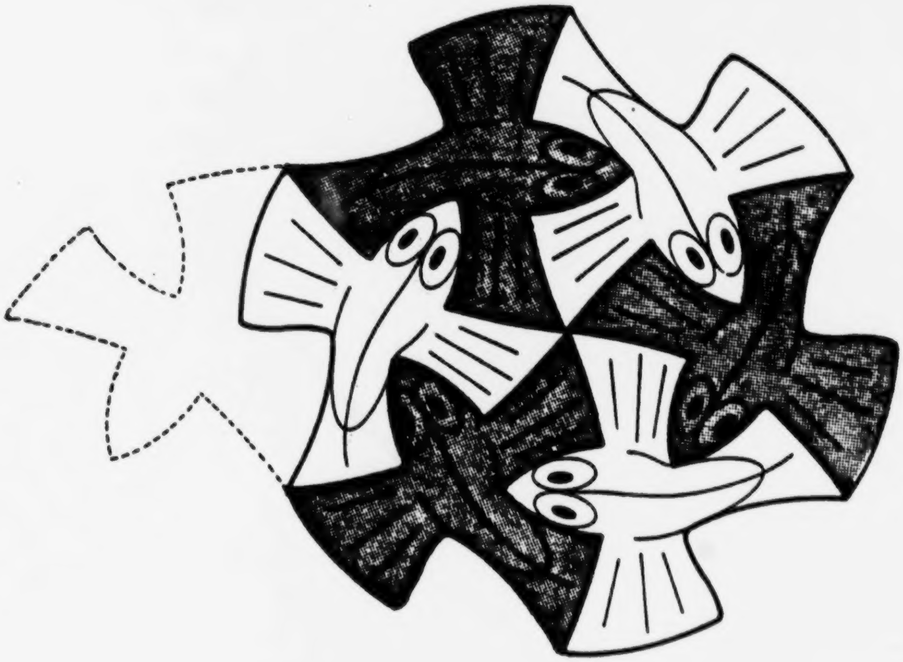
Sheet 3 TESSELLATING WITH HEXAGONS

The artist M. C. Escher(1898–1972) is well known for his use of tessellations. By skillfully altering a basic polygon, such as a triangle or hexagon, he was able to produce intricate, artistic tessellations. The figure used here is based on one of Escher's drawings.

Step 1: Start with equilateral triangle ABC. Mark off the same curve on both sides AB and AC as shown. Mark off another curve on side BC that is symmetric about the midpoint P. If you choose the curves carefully, as did Escher, an interesting figure suitable for tessellating will be formed.



Step 2: Six of these figures accurately fit together about a point forming a hexagonal array. Trace and cut out one of the basic figures and show how it can be used to continue the tessellation over the entire sheet.



PROBABILITY AND PI

September 1977

By Christian R. Hirsch, Western Michigan University, Kalamazoo, MI 49008

Teacher's Guide

Grade level: 7–12

Materials: Wire (coat hangers) or thin strips of wood, cutters, tagboard, compasses, scissors, phone book, and copies of sheets 1–3

Objectives: Students are to calculate estimates of π using Monte Carlo techniques and compare the relative accuracy of their approximations.

Procedure: Distribute worksheets to each student. Note that sheets 1 and 2 can also be completed using a checkerboard, with a corresponding scaling down of the other apparatus. In particular, for squares of length l, use a needle of length l and a saucer with radius $\frac{1}{4} l$.

You may wish to have students work on this activity in pairs. In this way, sheets 1 and 2 can be completed by having one pupil perform the indicated experiment while the other records the successes. On sheet 3 each student can check on the other's calculations. These experimental results can then be pooled to obtain a much larger sample, which should yield closer approximations for π and on which comparisons can be based.

The second experiment is amenable to further analysis, and some students might be encouraged to discover the mathematical rationale behind the probability formula. This can be done by a comparison of areas. Assume that the center of the saucer lands anywhere in a given square. The saucer will touch a vertex, provided its center is in one of the four quarter circles of the same radius centered at each vertex. Comparing this total area to the area of the square yields $\pi/16$.

The mathematics underlying the probability formulas on sheets 1 and 3 is beyond the scope of most secondary school students. However, completion of the third experiment will produce some very fruitful mathematical discussions. For example, how does one determine if two numbers are relatively prime? One possible way is to compare their prime factorizations, if simple divisibility tests are not productive. Is there an easier way? The Euclidean algorithm, illustrated below, is a particularly efficient technique for finding the greatest common factor (gcf) of pairs of large numbers.

To find the gcf of 840 and 329, proceed as follows:

$$\begin{aligned} 840 &= 329(2) + 182 \\ 329 &= 182(1) + 147 \\ 182 &= 147(1) + 35 \\ 147 &= 35(4) + 7 \\ 35 &= 7(5) + 0 \end{aligned}$$

The last nonzero remainder, which in this case is 7, will be the gcf. Hence, 840 and 329 are *not* relatively prime.

REFERENCES

Ogilvy, C. S., and J. T. Anderson. *Excursions in Number Theory*. New York: Oxford University Press, 1966.

Schaaf, W. L. *Nature and History of π*. Stanford, Calif.: School Mathematics Study Group, 1967.

Editorial comment: **The Monte Carlo method illustrated in this activity is an important problem-solving technique to which most students should be introduced. It permits students with relatively little mathematical background to obtain estimates of solutions for nontrivial probability and expected-value problems. As an example of the latter application, you might pose the following problem. Suppose a cereal manufacturer includes a felt-tipped pen of one of six different colors in each box. How many boxes of cereal would you expect to buy to get a complete set? Associate each number on a die with a pen color and roll the die until you have a pen of each color. Repeating this simulation several times and then finding the average number of boxes purchased will provide an estimate of the solution. Increasing the number of trials will improve the estimate. An elaboration of this problem can be found in the chapter by Kenneth J. Travers in NCTM's 1981 Yearbook, *Teaching Statistics and Probability*.**

SHEET 1

Tossing Needles

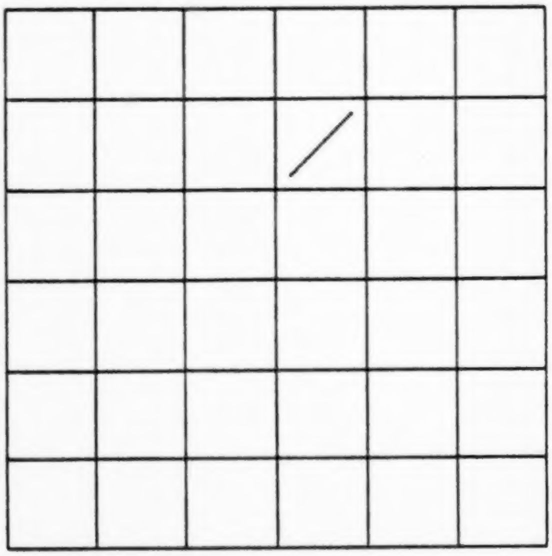
You probably first encountered the number π in your study of geometry. You learned that π is the ratio of the circumference of a circle to its diameter (C/d). This number, however, has many other interesting properties, some of which you will use in this activity to obtain decimal approximations of the value of π.

1. Observe your classroom floor. It is probably covered with square tiles.

2. From a piece of wire or a thin strip of wood, cut a needle the same length as a side of the square tile.

3. If you toss this needle up in the air, what is the probability that it will fall completely within one of the squares?

   a. One way of estimating this probability is to actually toss the needle 100 times and record the number(s) of successes--that is, how many times the needle falls completely within one of the squares.



Calculate s/100 to estimate this probability: ___________

   b. This value is also an estimate of π - 3.

   What would be your estimate of π ? ___________

4. Let n be the total number of needle tosses in your class and let t equal the total number of successful tosses. Find a class estimate for π by computing t/n + 3: _____________

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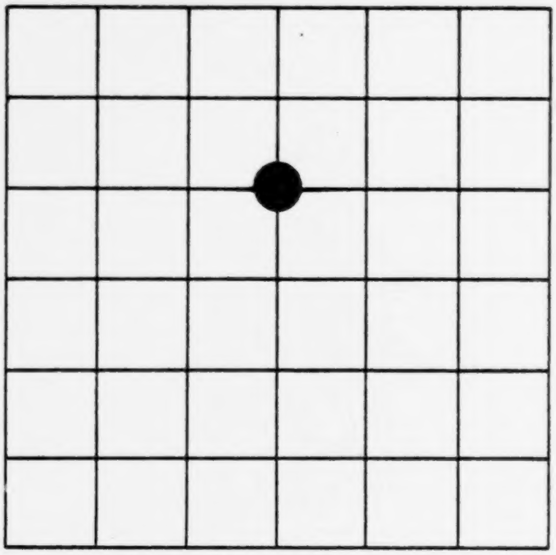
SHEET 2

Tossing Saucers

Here is another simple experiment for finding an estimate of π by using probability.

1. From a piece of tagboard, cut a circular saucer having a radius one quarter the length of a side of the square floor tile.

2. If you toss this saucer up in the air, what is the probability that it will land touching a vertex of one of the square floor tiles?



   a. Perform this experiment 100 times and record the number(s) of successes. Then compute the probability estimate, s/100:

   ____

   b. The value above is also an estimate of π/16.

   What would be your estimate of π this time? __________________

3. Let n be the total number of saucer tosses in your class and let t be the total number of times the saucer touched a vertex of a square.

   Determine a class estimate for π: ____________________

SHEET 3

Searching Phone Books

1. Recall that two positive integers are said to be relatively prime if they have no common factor other than 1. For example, 8 and 9 are relatively prime.

   If two numbers are written down at random, what is the probability that they will be relatively prime?

2. Let's actually perform the experiment. Below are ten pairs of numbers selected at random from telephone number suffixes.

First number	Second number	Relatively prime?
0762	3804	No
6006	0181	
3871	6622	
4129	2830	
1294	4257	
0585	9916	
8663	2531	
2890	8310	
9148	5433	
1620	0185	

   a. Determine which of these pairs of numbers are relatively prime.

   b. Randomly select ten more pairs of numbers from telephone number suffixes in a local phone book and determine which of these pairs of numbers are relatively prime.

   c. Let s equal the number of pairs that were relatively prime.

      Calculate the probability estimate s/20: ________________

   d. This value is also an estimate of $6/\pi^2$.

      Use your answer in part c to determine an estimate for π: ________________

3. Pool your results with those of other classmates to determine a class approximation for π: ________________

4. The value of π correct to 5 decimal places is 3.14159. Which of the three experiments yielded the closest class approximation?

CREATIVITY WITH COLORS

March 1976

By Christian R. Hirsch, Western Michigan University, Kalamazoo, Michigan 49001

Teacher's Guide

Grade level: 7–12

Materials: Colored pencils, one set of worksheets for each student, and a set of transparencies for class discussion

Objective: Students will discover the minimum number of colors required to properly color various types of planar maps.

Directions: It may be preferable to have students complete this activity working in small groups. Colored pencils can then be distributed to each group and a set of worksheets to each student. Note that regions that are to be the same color can be numbered with the same number, though many pupils find this method less enjoyable than coloring.

Sheet 1: Students should have little difficulty discovering that maps (a)–(f) can be properly colored using 3, 3, 4, 3, 2, and 4 colors, respectively.

Sheet 2: In this activity students should be required to form several maps of each type before generalizing. Maps formed as in questions 2 and 4 can always be properly colored using only two colors. Problem 6 requires three colors.

Pupils who have had some work with mathematical induction may wish to try proving their generalizations. Others might be encouraged to create their own coloring problems (e.g., How many colors are needed to properly color various tessellations? What would happen if, in question 4, circles were replaced by polygons such as rectangles?).

Sheet 3: Students color actual maps using the least number of colors possible. All maps in problem 7 require the use of four colors. Question 8 leads up to the famous four-color conjecture. Though it has been proved that no more than five colors are needed, it is conjectured that four are sufficient. A brief historical account and proof of the five-color theorem may be found in Ore (1963).

REFERENCES

Dynkin, E., and V. Uspenskii. *Mathematical Conversations, Part I: Multicolor Problems.* Translated by N. Whaland, Jr. and R. Brown. Boston: D. C. Heath & Co., 1963.

Ore, Oystein. *Graphs and Their Uses.* New York: Random House, 1963.

Editorial comment: **A proof of the four-color conjecture was completed in June 1976 by two mathematicians, Kenneth Appel and Wolfgang Haken, at the University of Illinois. Their proof required 1200 hours of computer time. In fact, its correctness cannot be checked without the use of a computer. A nontechnical description of their method of proof can be found in *Scientific American* (October 1977).**

SHEET 1

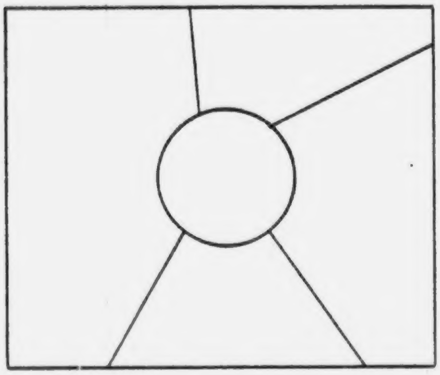
CREATIVITY WITH COLORS

Most maps are made so that countries or states next to each other are different colors. Maps are colored so that

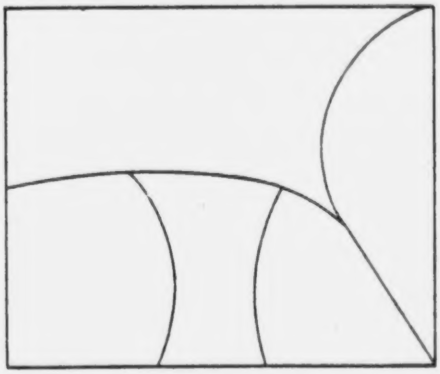
a. No two regions with a common boundary have the same color.
b. Regions that meet only at 1 point can be the same color.

1. Color these maps using the rules above. Color the complete region inside the rectangle. Use the fewest colors possible.

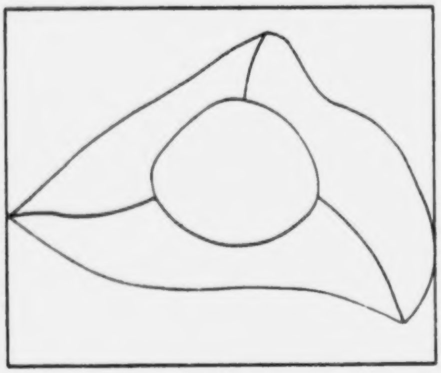
a.



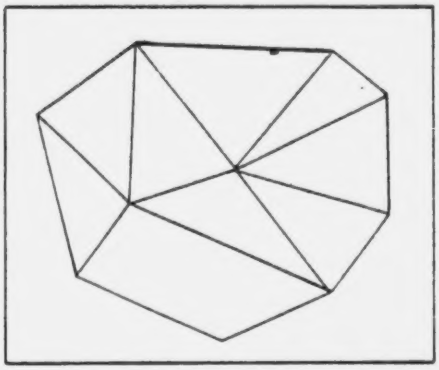
b.



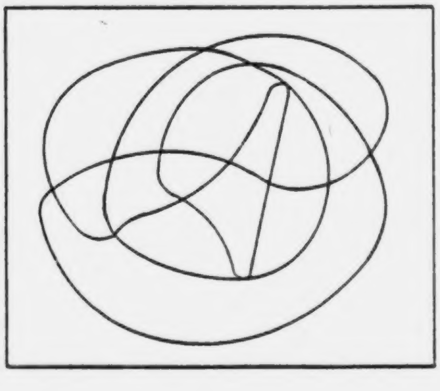
c.



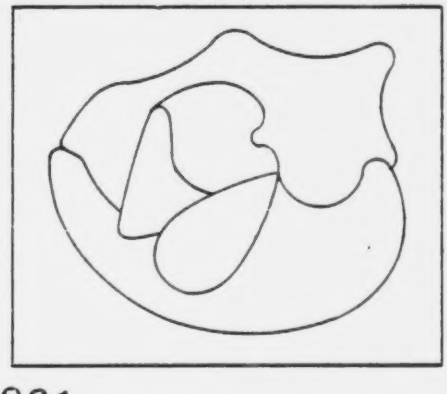
d.



e.



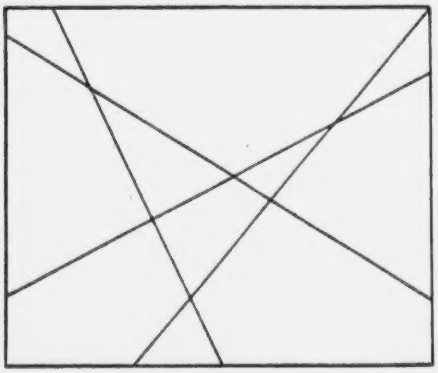
f.



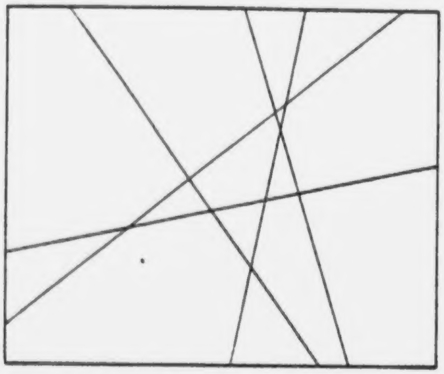
SHEET 2

2. Suppose a map is formed by drawing any number of straight lines in the plane. Color the maps as before.

a.



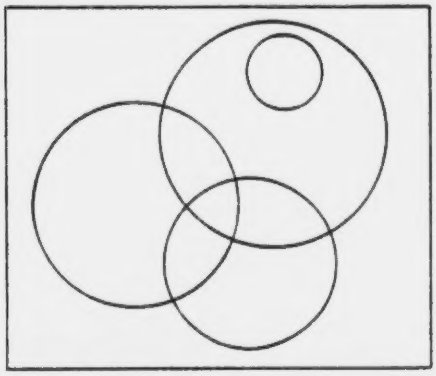
b.



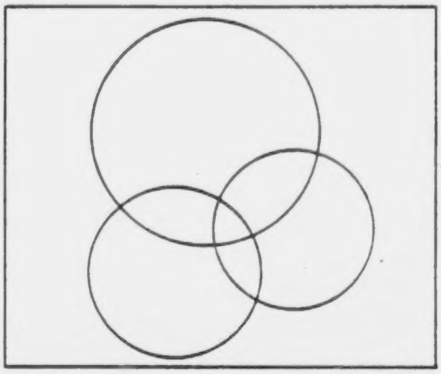
3. Draw several more maps and determine the least number of colors needed for maps of this type.

4. These maps are formed by drawing any number of circles in the plane. Color the maps as before.

a.



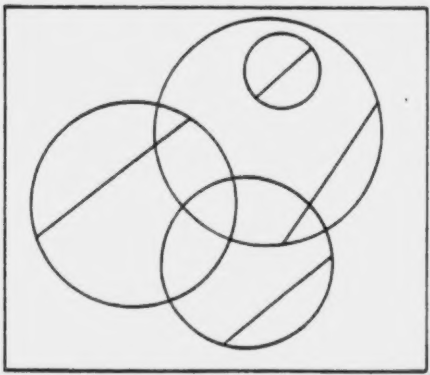
b.



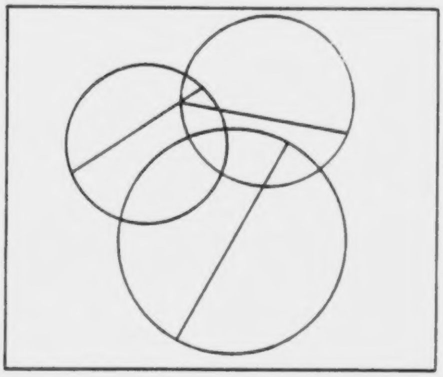
5. Draw several more maps and determine the least number of colors necessary to color maps formed in this way.

6. These maps are formed by drawing circles and then, in each circle a chord is drawn such that chords of two different circles have at most one point in common. How many colors are needed to color these maps?

a.



b.



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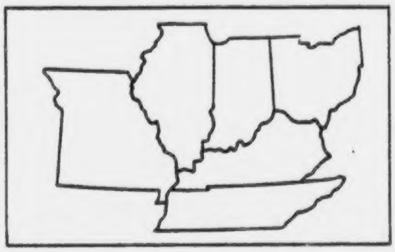
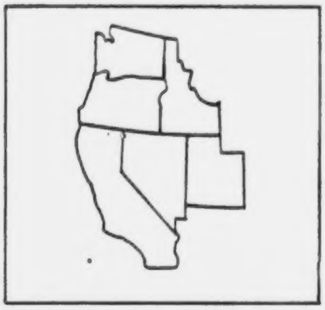
SHEET 3

7. Color these maps. Use the least amount of colors possible.

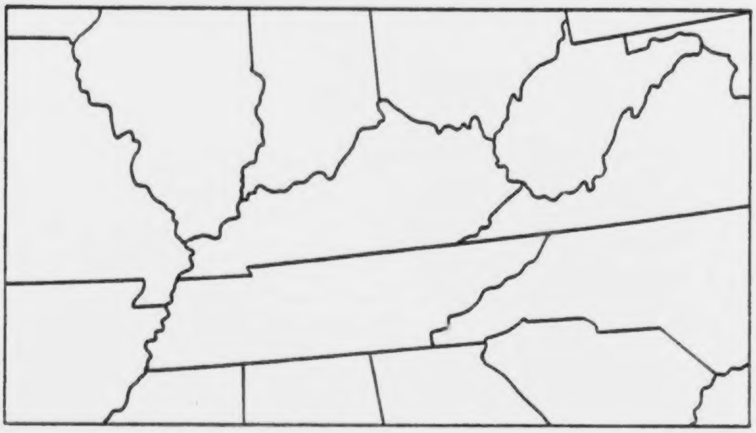
a.



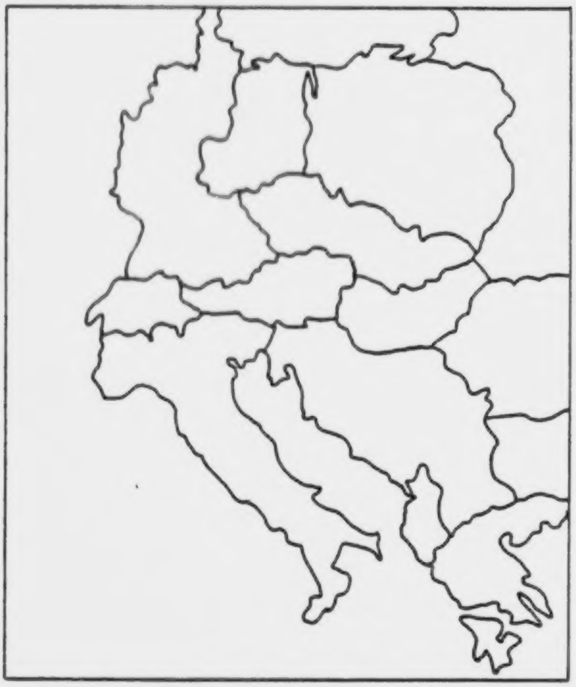
b.



c.



d.



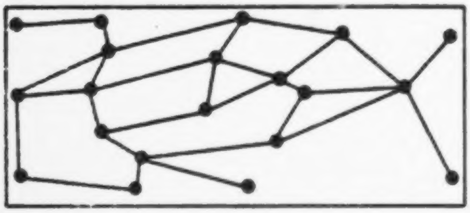
8. Can you draw a map that cannot be colored with fewer than five colors?

•• 1

EN AUTOBUS
(Going) by bus

Voici un réseau d'autobus dans une ville. Écris, à côté de chaque point, le nombre de directions que l'on peut suivre à partir de ce point.

Here is a bus route network in a town. Write near each dot the number of directions one can follow starting at each point.



Écris maintenant, dans la deuxième ligne du tableau ci-dessous, le nombre de points à partir desquels on peut prendre une direction, ou deux, ou trois, ou quatre, ou cinq:

Now write down in the chart below the number of points from which one can follow a direction, or 2, or 3, or 4, or 5 directions.

	1	2	3	4	5	directions possibles possible directions
à partir de from	4					points points

Dessine un réseau d'autobus tel que l'on puisse partir vers:

Draw a bus network one could take going to work.

	1	2	3	4	5	directions possibles possible directions
à partir de from	2	3	3	1	1	points points

Même chose avec ce tableau:

Do the same with this chart:

	1	2	3	4	5	directions possibles possible directions
à partir de from	1	2	3	2	2	points points

•• 1 (suite)

Même chose encore:
The same thing again:

	1	2	3	4	5	directions possibles
à partir de from	1	2	2	0	0	points

Même chose encore:
The same thing again:

	1	2	3	4	5	directions possibles
à partir de from	1	2	2	0	1	points

Même chose encore:
The same thing again:

	1	2	3	4	5	directions possibles
à partir de from						points points

Ici, c'est à toi de proposer des nombres, avant de faire le dessin.
Here you should provide the numbers before doing the drawing.

Est-il toujours possible de tracer un réseau à partir d'un tableau donné? ________ . Sinon, essaie de prédire, pour un tableau quelconque, si ce sera possible ou non, puis contrôle ta prédiction.

Is it always possible to draw a network from a given chart? ________
If not, try any chart and see if this is possible or not; then, check your prediction.

•• 2

LE VILLAGE ET LES CHATEAUX

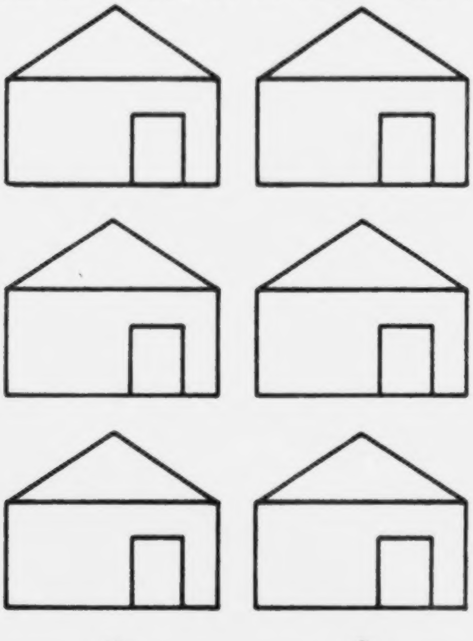
THE VILLAGE AND THE CASTLES

Jean colorie les maisons d'un village. Il ne dispose que de trois couleurs: rouge, bleu et jaune. Il veut colorier les maisons, en utilisant chaque fois une couleur pour le toit, une autre pour la porte et une autre pour le mur.

Combien peut-il colorier de maisons, s'il veut qu'elles soient toutes différentes? ________ .

Jean colors the houses in a village. He has only three colors; red, blue and yellow. He wants to color the houses, using each time one color for the roof, another for the door and another for the wall.
How many houses can he color, if he wants them to be totally different?

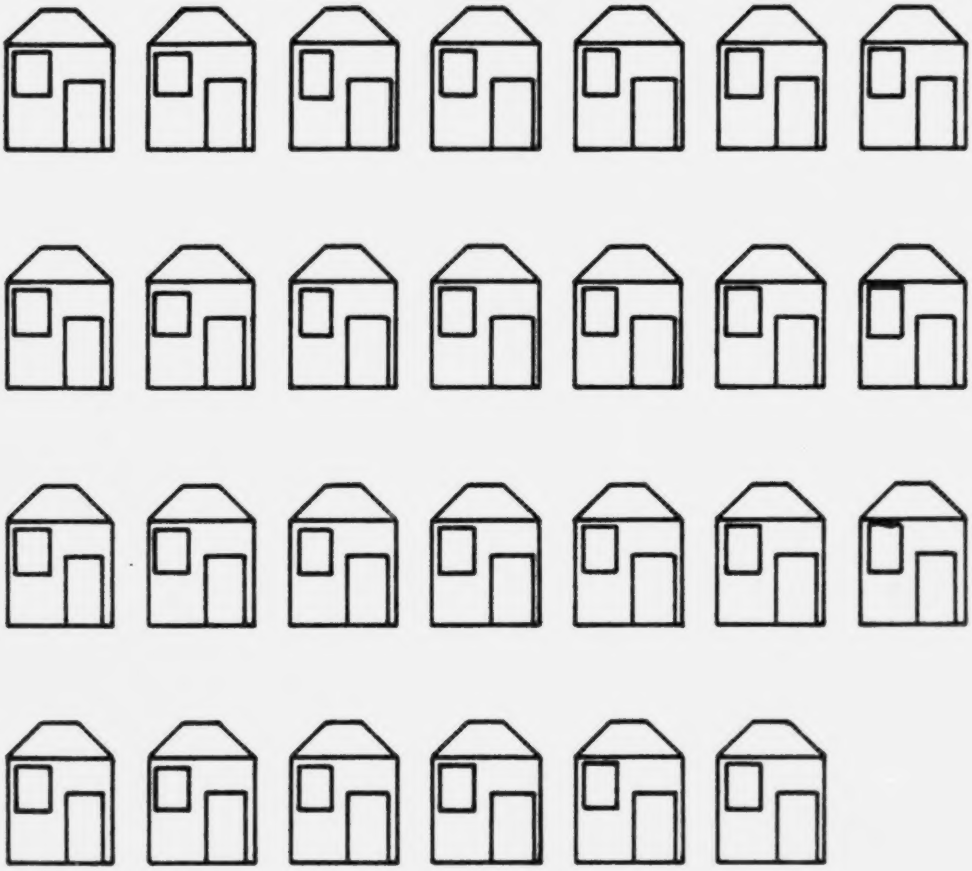
____



•• **2** (suite 1)

Même question avec quatre couleurs différentes: une pour le toit, une pour la porte, une pour la fenêtre et une pour le mur:

The same question with four different colors: one for the roof, one for the door, one for the window, and one for the wall:



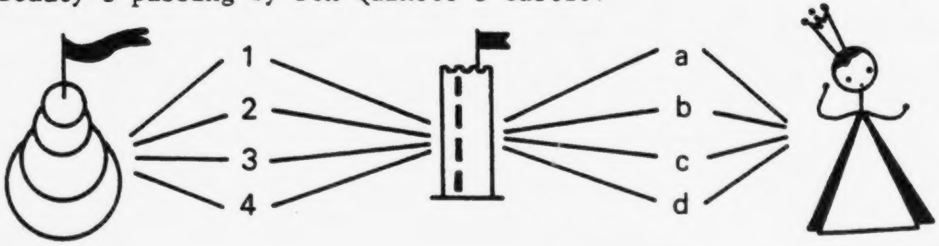
On peut colorier différemment ________ maisons.

One can color ____________ houses in a different way.

•• 2 (suite 2)

Combien de chemins peut-on emprunter pour aller du château de Barbe-bleue à celui de la Belle-au-bois-dormant, en passant par le château de Don Quichotte?

How many paths can one take to go from Blue Beard's castle to Sleeping Beauty's passing by Don Quixote's castle?



Écris ainsi les chemins: 1a, 1b, ____________________.

Write down the paths in this way: 1a, 1b, ____________________.

Le nombre de chemins trouvés est: ________.

The number of paths found is:________________.

•• 3

MOTS IMAGINAIRES

IMAGINERY WORDS

Construis des mots imaginaires à partir des lettres A, A, B, B.
Construct imaginery words from the letters A, A, B, B.

Par exemple, AABB, ABAB, ______________________ .
For example, AABB, ABAB,____________________.

Combien y en a-t-il? _______ .
How many in all?_____________.

Remplis maintenant le tableau suivant:
Now fill in the table below:

A partir de ces lettres: From these letters:	on peut former les mots: One is able to form these words.	Nombre de possibilités Number Possible
A, A	AA	1
A, A, B		
A, A, B, B	AABB ABAB ABBA BABA BBAA BAAB	6
A, A, B, B, B		
A, A, B, B, B, B		

•• 3 (suite)

Remplis ensuite ces tableaux (en écrivant les mots à part):
Then fill in these charts (by writing the words separtely):

Lettres Letters	Nombre de mots
A, A, A	
A, A, A, B	
A, A, A, B, B	
A, A, A, B, B, B	

Lettres Letters	Nombre de mots Number of Words
A, A, A, B, B, B, B	

(Ici, continue à faire les listes de lettres sur le même modèle) Now go on making the lists of letters following the same pattern.

Prolonge cette suite de nombres: 1, 3, 6, 10, 15, ________ ...
Continue with this sequence of numbers:

Et celle-ci: 1, 4, 10, 20, 35, ________________________ ...
And this one:

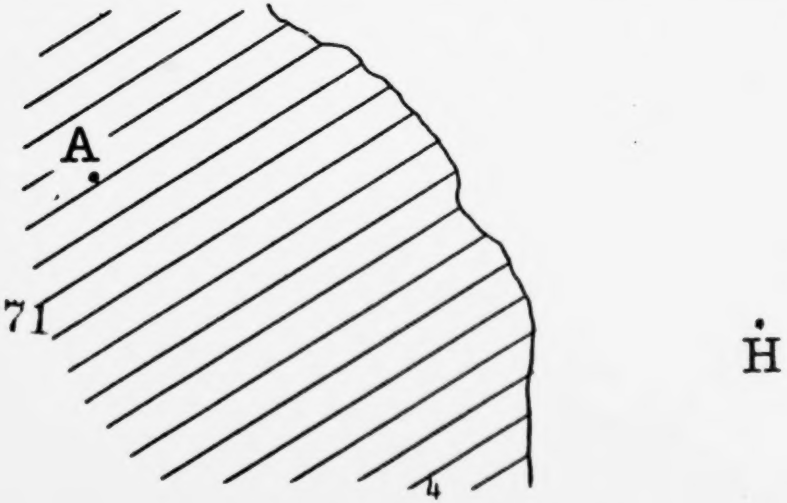
This is part of a table of values of $3S^2 + T^2$. Values of S are down the left-hand side and values of T along the top. Investigate any patterns you can find in this table.

(You may need to extend it to larger values of S & T)

133

	1	2	3	4	5	6	7	8	9	10	11	12	13
1	4	7	12	19	28	39	52	67	84	103	124	147	172
2	13	16	21	28	37	48	61	76	93	112	133	156	181
3	28	31	36	43	52	63	76	91	108	127	148	171	196
4	49	52	57	64	73	84	97	112	129	148	169	192	217
5	76	79	84	91	100	111	124	139	156	175	196	219	244
6	109	112	117	124	133	144	157	172	189	208	229	252	277
7	148	151	156	163	172	183	196	211	228	247	268	291	316
.	...	...	...	...	...	...	...	...	...	...	...	...	...

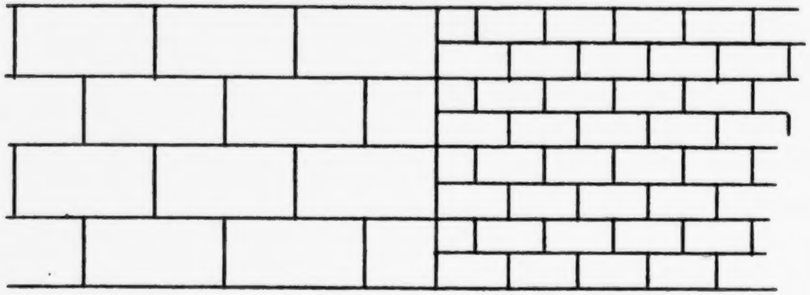
In this map the shaded area is desert which can only be crossed at 15 kph. The unshaded area is grassland which can be crossed at 60 kph. How should E.X.Plorer get from Addahernia to Hospitalia as quickly as possible ?



1271

This picture shows the appearance of a wall I noticed recently. The brickwork on the right seems to be exactly half the size of that on the left, but actually the wall zig-zags and it is just further away on the right.

Your problem is to say whether it is exactly twice as far way ?

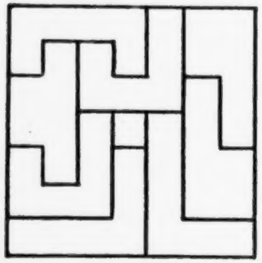


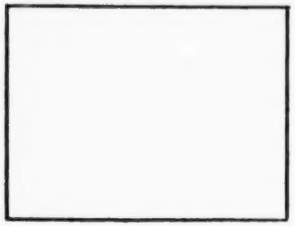
Here are two sequences of numbers. If each sequence goes on for ever, which sequence has the most numbers in it ?

(A) 1 2 3 4 5 6 7 8 9 10 11 12 13 14 ....

(B) 1 4 9 16 25 36 49 64 81 100 121 144 ...

Copy the figure on the left on squared paper, cut out the pieces and rearrange them to make the figure on the right.





1272

Find as many pairs of numbers as you can which fit this equation:

$$2p + 3q = 25$$

Investigate patterns between these number pairs.

134

$7 \times 5 = 35$ $\quad$ $3 + 5 = 8$
$77 \times 55 = 4235$ $\quad$ $42 + 35 = 77$
$777 \times 555 = 431235$ $\quad$ $431 + 235 = 666$
....

Investigate

$8 \times 3 = 24$ $\quad$ $2 + 4 = 6$
$88 \times 33 = 2904$ $\quad$ $29 + 4 = 33$
$888 \times 333 = 295704$ $\quad$ $295 + 704 = 999$
....

Investigate

$333 \times 444 = 147852$ $\quad$ $147 + 852 = 999$
$333 \times 777 = 258741$ $\quad$ $258 + 741 = 999$
$666 \times 777 = 517482$ $\quad$ $517 + 482 = 999$
... ...

Investigate

The decimal for one seventh is $0.\overline{142857}$ and $142 + 857 = 999$: Is this a complete coincidence, or is there a connection with the last patterns above ?

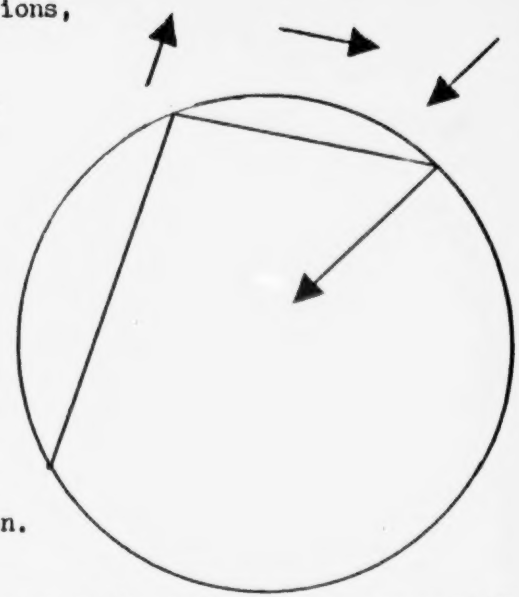
Find three whole numbers, a, b and c, which will make this fraction a whole number :

$$\frac{bc + ca + ab}{a + b + c}$$

~~1273~~

Prove that if p^2 is exactly divisible by $p+q$, then q^2 is exactly divisible by $p+q$ also. (p and q are both whole numbers.)

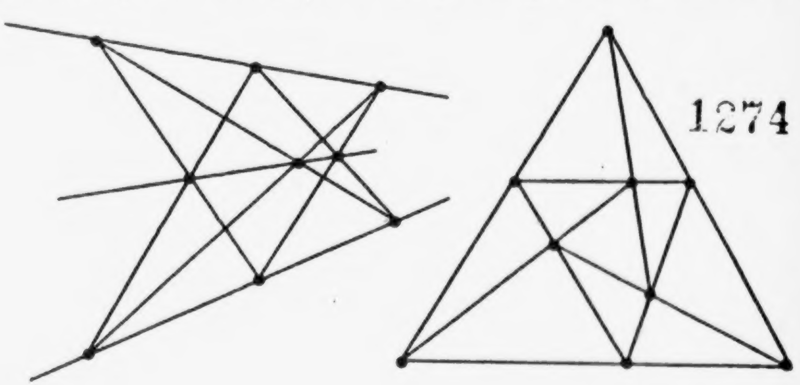
Choose three directions, like this:



Then draw a circle, choose a point on it to start from, and set off in the first direction. Change to the second direction when you meet the edge, ...change to the third direction..... back to the first direction, and so on.

Investigate.
What happens if more than three directions are used ?

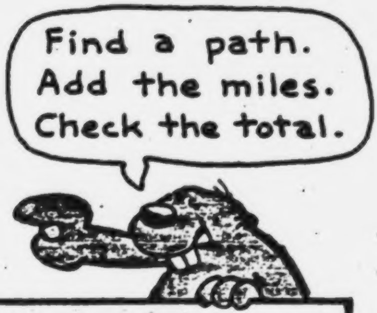
These two diagrams each show 9 points and 9 lines, with three points on every line and three lines through each point. Your problem is to say whether these two diagrams are really the same, or if they are genuinely different.



1274

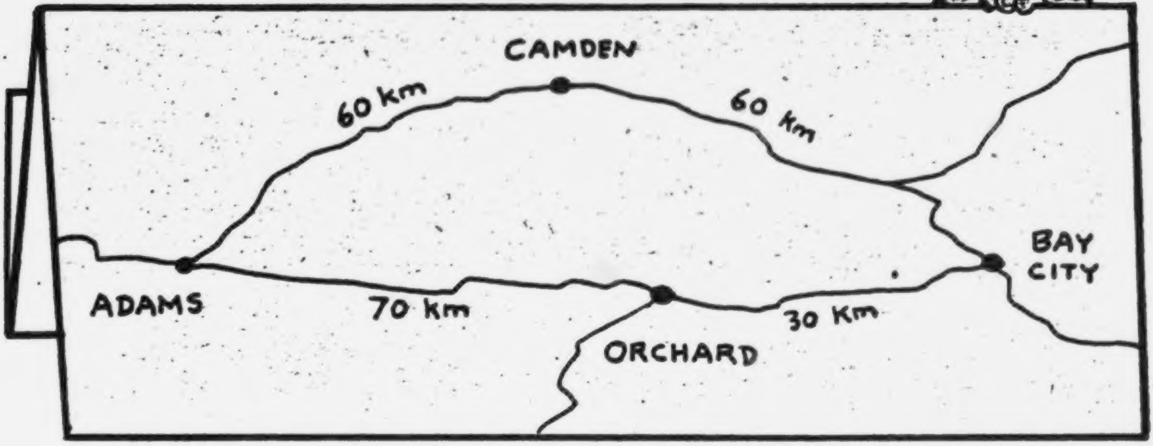
MAKING GUESSES

FIND THE PATH


Find a path.
Add the miles.
Check the total.

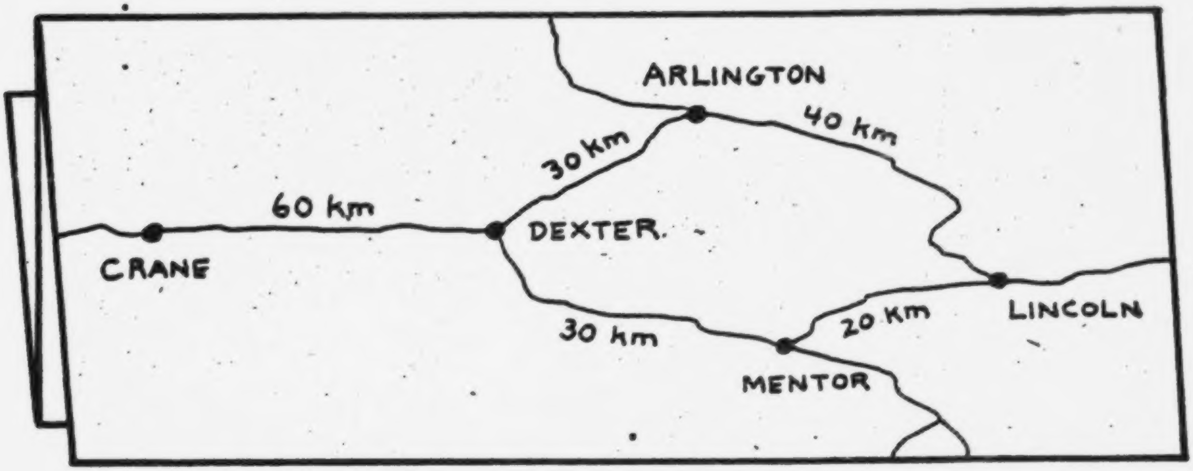
1. Mr. Henry traveled from Adams to Bay City.
He traveled a total of 100 kilometers.
He stopped in one city along the way.

Where did Mr. Henry stop? ______________

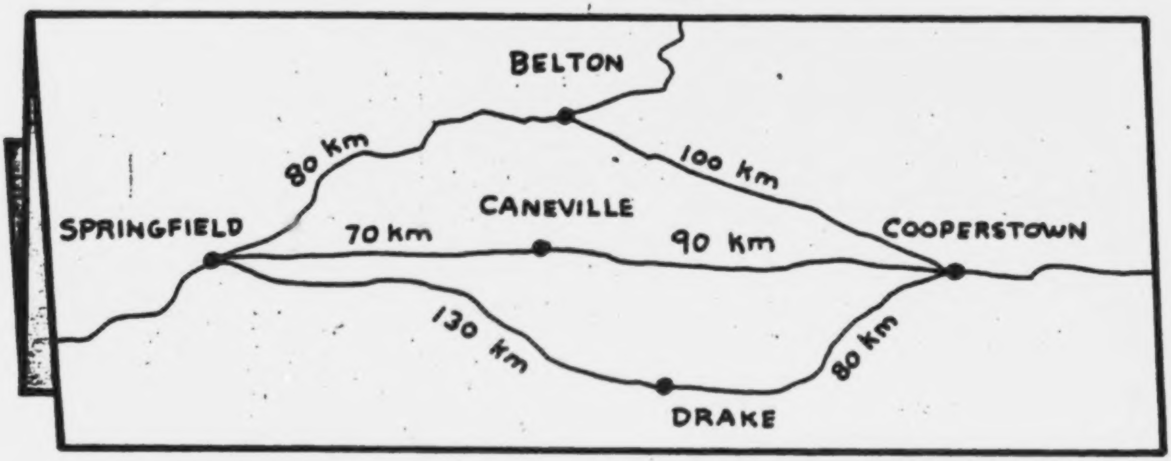

CAMDEN
60 km
60 km
BAY CITY
ADAMS
70 km
ORCHARD
30 km

2. Mrs. Carry traveled from Crane to Lincoln.
She traveled a total of 130 kilometers.
She stopped in 2 cities.

Mrs. Carry stopped in Dexter and ______________.


ARLINGTON
40 km
30 km
60 km
CRANE
DEXTER
LINCOLN
20 km
30 km
MENTOR

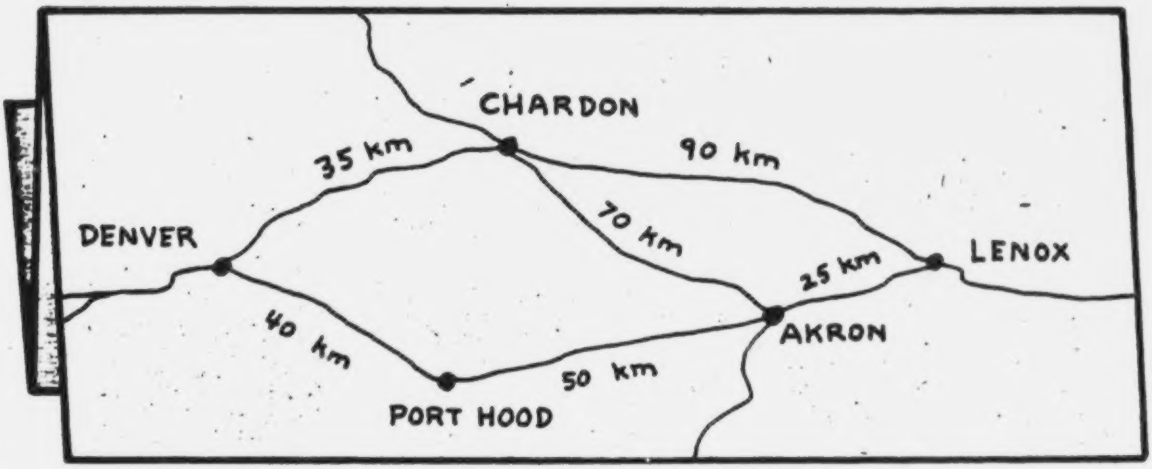
3.


BELTON
80 km
100 km
CANEVILLE
SPRINGFIELD
70 km
90 km
COOPERSTOWN
130 km
80 km
DRAKE

Ms. Donald traveled from Springfield to Cooperstown.
She took the shortest route.

What city did she pass? ______________

4.


CHARDON
35 km
90 km
DENVER
70 km
25 km
LENOX
AKRON
40 km
50 km
PORT HOOD

Mr. Featherstone traveled from Denver to Lenox.
He traveled 130 kilometers. He stopped in 2 cities.

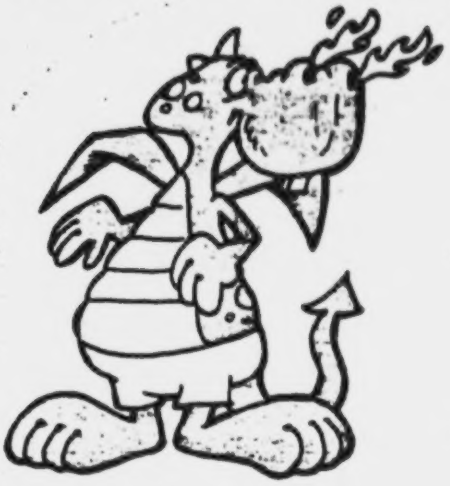
Where did he stop? ______________ and ______________.

FINDING THE DRAGON

My dragon:

- has 3 arms.
- is wearing shorts.
- is breathing fire.
- has 4 toes on each foot.
- has 2 teeth.

Look at each picture. Check the facts that fit. Use a ✓.



This dragon:

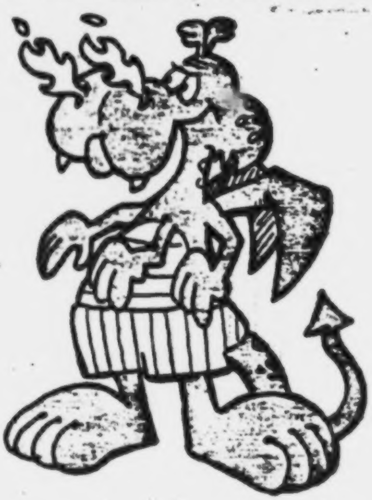
____ has 3 arms.

____ is wearing shorts.

____ is breathing fire.

____ has 4 toes on each foot.

____ has 2 teeth.



This dragon:

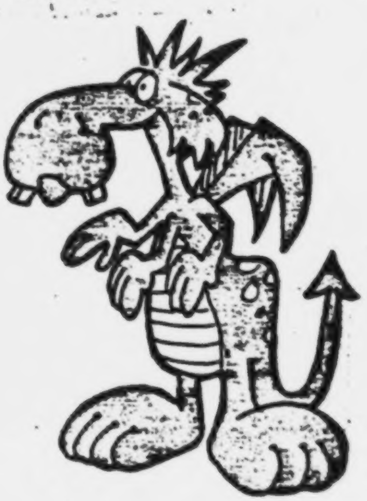
____ has 3 arms.

____ is wearing shorts.

____ is breathing fire.

____ has 4 toes on each foot.

____ has 2 teeth.



This dragon:

____ has 3 arms.

____ is wearing shorts.

____ is breathing fire.

____ has 4 toes on each foot.

____ has 2 teeth.

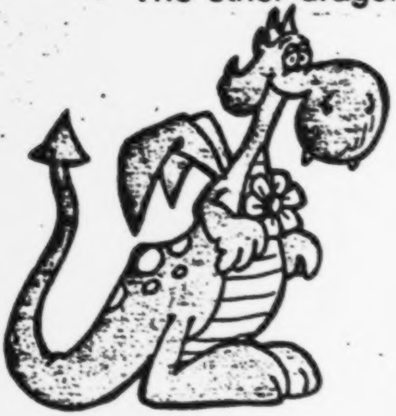
My dragon fits all the facts. Circle my dragon.

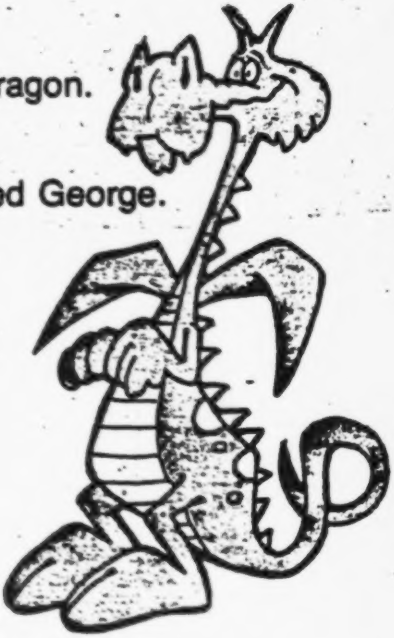
NAMING THE DRAGONS

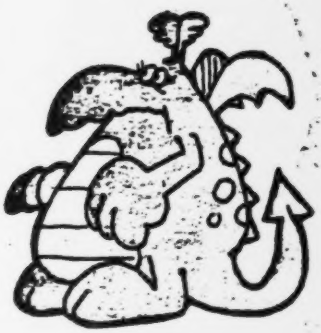
**Use the facts to help you name each dragon.
Write the correct name under each picture.**

1. FACTS

- Hester is *not* the tallest dragon.
- Jake is wearing a flower.
- The other dragon is named George.



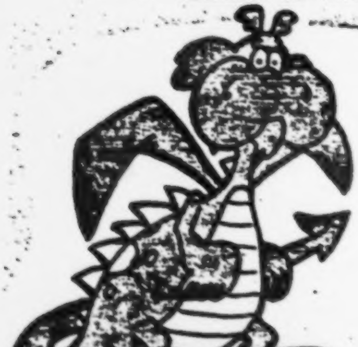


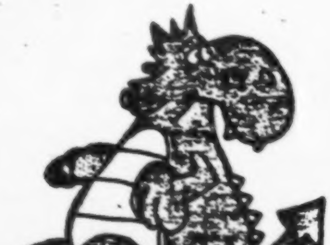


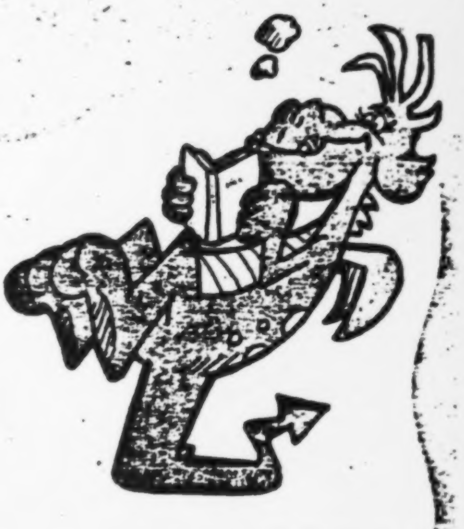
______ ______ ______

2. FACTS

- Horace is the dragon with 7 toes on each foot.
- Samantha is *not* the shortest dragon.
- Isabel is the other dragon's name.







______ ______ ______

SOLVING AGE PROBLEMS

Solve each problem.

1. How old are Kara and Lila?
   - Kara is 3 years older than Lila.
   - The sum of their ages is 11.

   Kara is ______ years old.

   Lila is ______ years old.

2. How old are Rover and Queenie?
   - The product of their ages is 36.
   - Queenie is 5 years younger than Rover.

   Rover is ______ years old.

   Queenie is ______ years old.

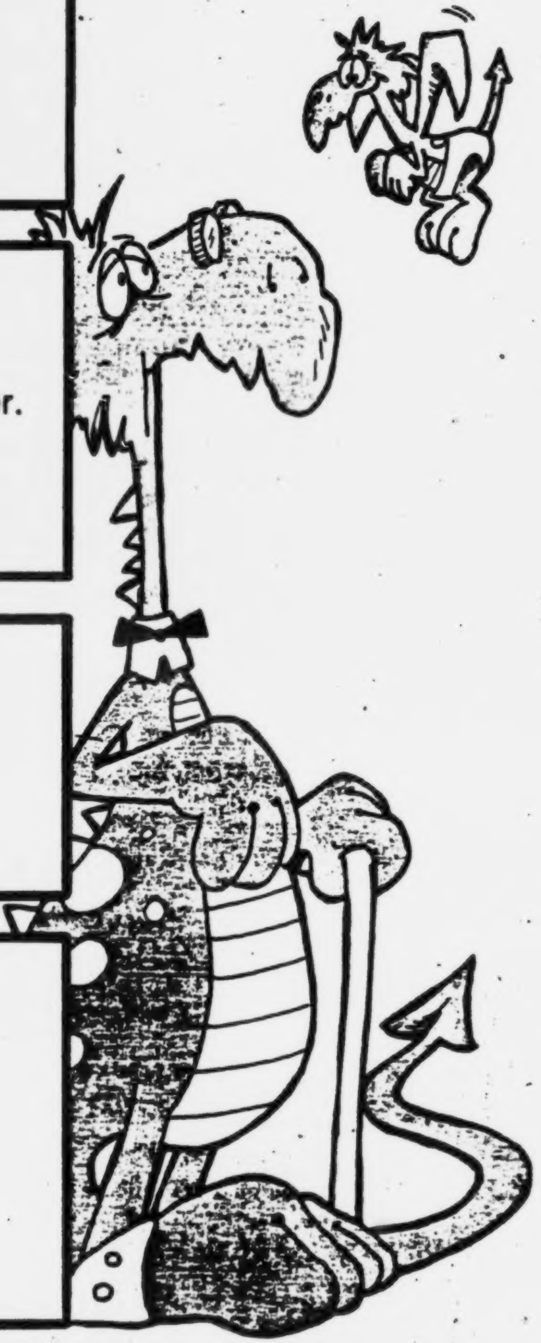
3. How old are Tim and Joan?
   - They are the same age.
   - The product of their ages is 64.

   Tim and Joan are ______ years old.

4. How old are Earl and Pearl?
   - The sum of their ages is 24.
   - Pearl is older than Earl.
   - The difference of their ages is 4.

   Pearl is ______ years old.

   Earl is ______ years old.



MISSING FACTS?

Solve the problems that have enough facts.
Draw an X through the problems that do *not* have enough facts.

TO BEE OR NOT TO BEE

1.

On Bubble Day there were 46 adults and 295 children. How many more children were there than adults?

____

2.

In the BIGGEST BUBBLE contest, each contestant blew three bubbles. There were a total of 267 bubbles. How many contestants were there?

____

3.

In the LONGEST LASTING BUBBLE contest, Ed's bubble lasted 15 seconds longer than Marta's bubble. How many seconds did Marta's bubble last?

____

4.

There were a total of 15 contests. Four prizes were given at each contest. How many prizes were given altogether?

____

5.

The first place winners were each given a life-long supply of soap. How many kilograms of soap did the winner get?

____

Name ______________________

HO HUM

Ask kids you know, "Are these boring?"
Then read the items on the list.

Keep a tally of their answers.

Item	Yes	No	Not sure
Taking a bath			
Riding a bus			
Flying in a plane			
Watching TV			
Cleaning house			
Reading			
Rollerskating			
Visiting friends			
Going out to eat			
Being alone			
Answering questions			
Getting dressed			
Riding bikes			
Swimming			
Eating			
Shopping			
Memorizing			

Answer each question about your tally.

1. Which item bored kids the most? ____________
2. Which item bored kids the least? ____________
3. How many kids answered your questions? ____________

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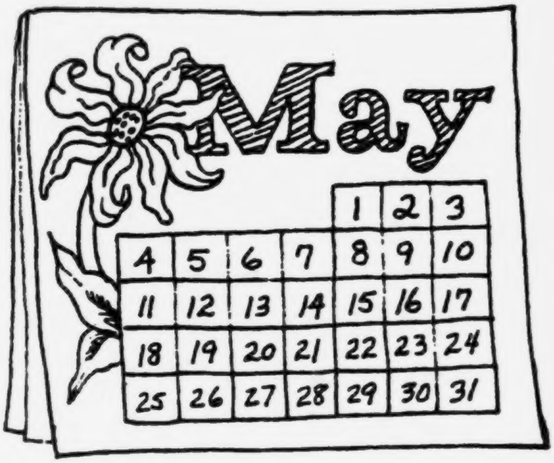
Name ______________________

CALENDAR CHARTS

You can make tally charts about the numbers in a calendar.

1. Complete the chart about the calendar.

digit	number of times
0	|||
1	𝍸 𝍸 ||||
2	
3	
4	
5	
6	
7	
8	
9	

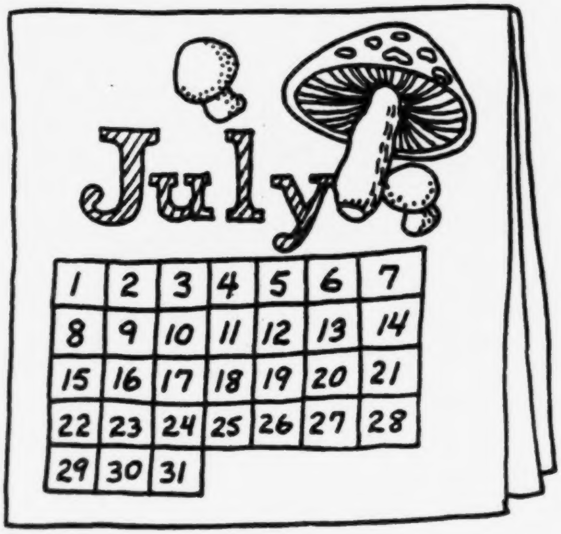


				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

2. Which digit occurs most often in May? ____________

3. Make a chart about July.

digit	number of times



1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

4. Which digit occurs most often in July? ____________

5. Is your answer the same as for May? ____________

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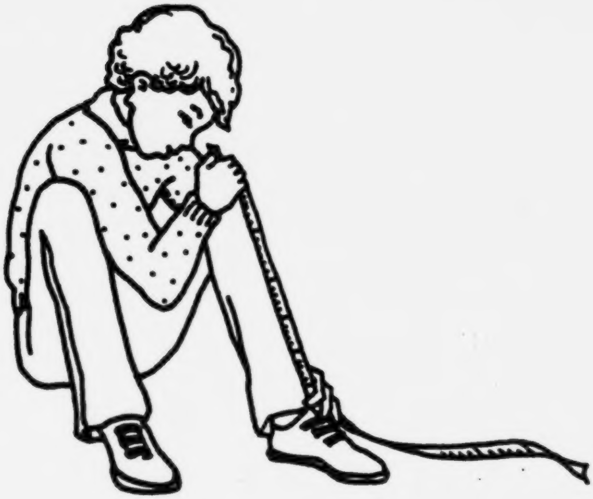
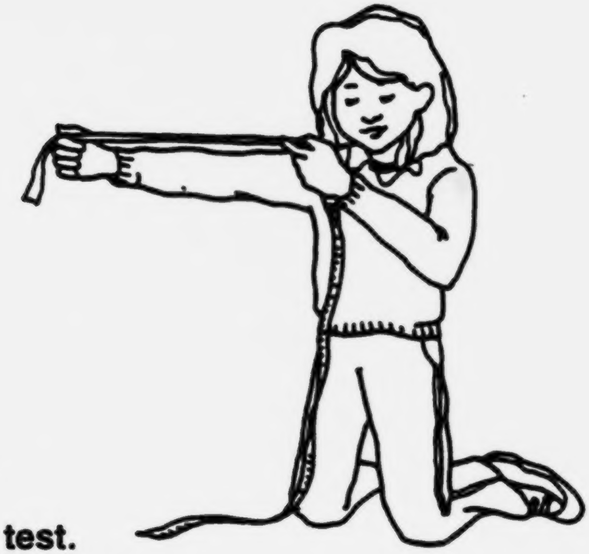
Name ______________________

DO YOU MEASURE UP?





Complete the chart. First guess, then test.
Use a tape measure. Make up more by yourself.

Parts of Me	Guess Measurement	Test Measurement
1. my height		
2. my widest smile		
3. my head (top to chin)		
4. my longest arm		
5. my ankle		
6. my thumb		
7.		
8.		
9.		
10.		

Are you a good guesser? yes no

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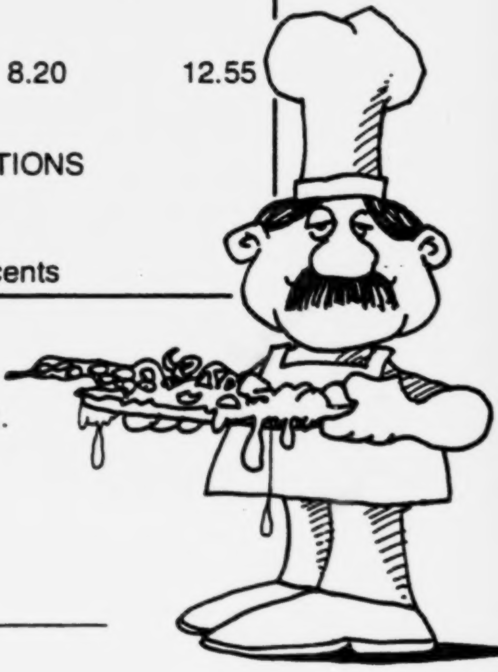
Name ______________

PAULO'S PIZZA

	10" Small	12" Medium	16" Large	24" Family
Cheese only ______	2.05	2.65	4.15	6.80
+ 1 item ______	2.40	3.20	4.90	7.90
+ 2 items ______	2.75	3.75	5.65	9.00
Combination ______	3.15	4.45	6.70	10.45
cheese pizza with salami, pepperoni, olives, mushrooms, and sausage	NO SUBSTITUTIONS			
Supreme ______	3.90	5.50	8.20	12.55
Combination with green pepper, onions, tomatoes, and extra cheese	NO SUBSTITUTIONS			

EXTRA CHEESE add 50 cents



You and your friends have $20 to spend.
How many of each kind of pizza can you buy?
How much change will you get? Assume there is no tax.

1. small cheese ______ ______
2. small cheese with mushrooms ______ ______
3. large cheese ______ ______
4. large cheese with pepperoni and olives ______ ______
5. medium combination ______ ______
6. family supreme ______ ______
7. medium cheese with sausage and extra cheese ______ ______
8. family combination with extra cheese ______ ______

Ingrid is having a pizza party for 18 people, including herself.
She figures that each person can eat one small pizza. Four people can eat a family pizza.

9. How many small pizzas must she order? __________
10. How much will the pizza cost if she orders supreme? __________
11. If Ingrid orders family pizzas, how many must she order? __________
12. How much will they cost? __________

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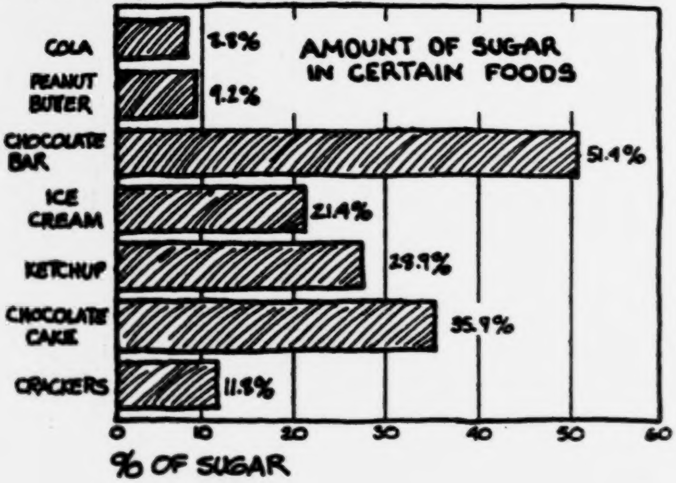
Name ____________________

BAR GRAPHS

Bar graphs make it easy to compare facts.
They help you to see relationships quickly.



SIOUX CITY DENTAL CLINIC

Each part of a bar graph has a purpose.

- The **title** tells what it's about.
- The **labels** tell what kinds of facts are listed and how much or how many of each.
- The **bars** show the facts.
- The **facts** give the information and usually are listed in some kind of order.

Take a QUICK GLANCE at the bar graph and answer these questions.

1. What is the bar graph about? ____

____

2. Which food on the graph has the greatest percentage of sugar? ________________
3. Which food on the graph has the least percentage of sugar? ________________

Now take a closer look at the bar graph and answer these questions.

4. Which food has a greater percentage of sugar, ketchup or ice cream? ________________
5. What is the difference in the percentage of sugar in chocolate cake and chocolate bars? ________________
6. How many percentage points difference is there between the food with the greatest percent of sugar and the food with the least? ________________
7. List the foods according to the percent of sugar, from least to greatest.

____

8. The labels across the side of the graph represent various percents. They start at what number and end at what number? ________________

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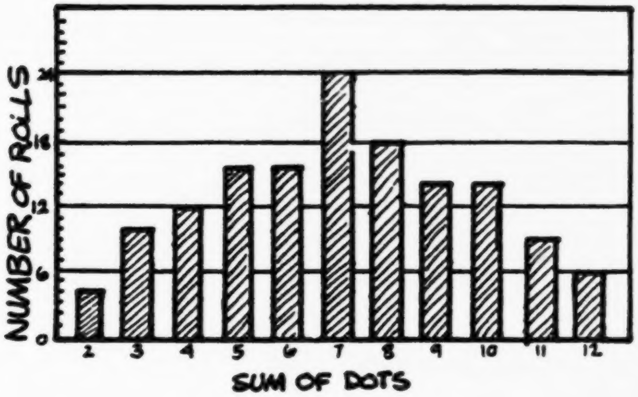
Name ____________________

DICE DETECTOR

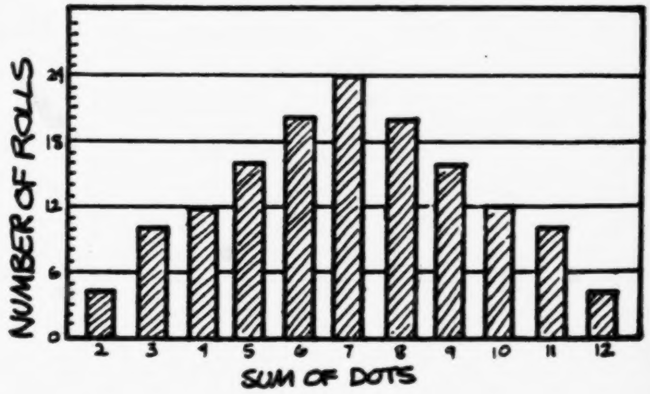
Four different people have their own dice. They each rolled their dice 144 times. Graphs were made to show the results. Match the correct names to the graphs. Use these clues.

- Anita Win rolled more sevens than anyone else.
- Willy Maykett had 4 twelves.
- Bette A. Million had 5 more tens than elevens.
- Ben D. Rules has unfair dice.

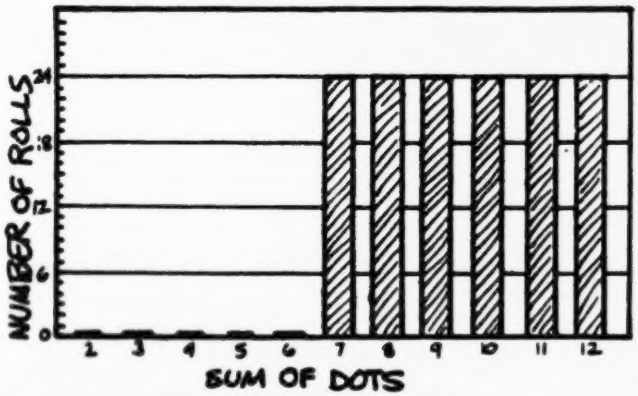
1. ____________________



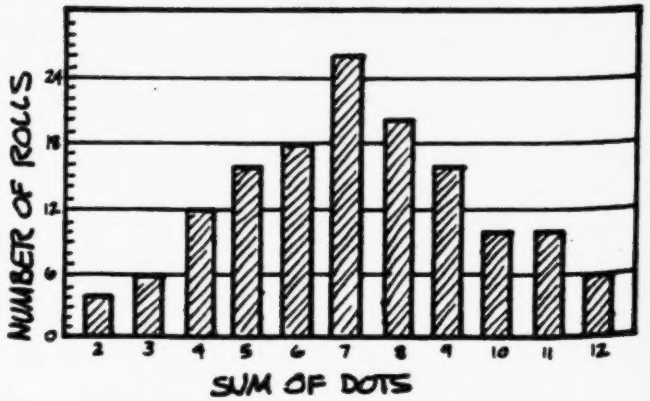
2. ____________________



3. ____________________



4. ____________________



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IONESTIMATIONESTIMATIONESTIMATION ______________ ESTIMA

CHECKING THE ANSWERS

Check this person's work! Find the 8 errors.
Don't rework the problems.
Just look for unreasonable answers.

This is a timed exercise.
You have 3 minutes. Begin
when the timer says "GO."

1 GROSS
CHECKS

Name Jayne Payne

Add.

1. 68,342 + 275 + 9,476

2. 458 + 174 + 649 + 362

3. 74 + 5,492 + 67,789 + 446 + 52,473

Subtract.

4. 8,749 − 2,345

5. 83,597 − 61,428

6. 8,294,521 − 27,512

7. 58,000 − 32,046 =
8. 33,747 − 912 =
9. 842,000 − 16,777 =

Multiply.

10. 1,806 × 5

11. 15,795 × 3

12. 987 × 99

13. 21 × 79 =
14. 2 × 7 × 9 =
15. 200 × 53 =

Divide.

16. 6)846
17. 5)6,995
18. 4)29,784
19. 23)97
20. 24)984
21. 48)74,976
22. 16,272 ÷ 36 =
23. 363,561 ÷ 23 =

ANSWERS

1. 78,093
2. 1,643
3. 12,627
4. 11,094
5. 52,169
6. 8,267,009
7. 25,954
8. 34,835
9. 825,223
10. 9,030
11. 74,385
12. 87,843
13. 1,659
14. 126
15. 1,060
16. 141
17. 139
18. 7,446
19. 4 R5
20. 41
21. 1,562
22. 45 R2
23. 15,807

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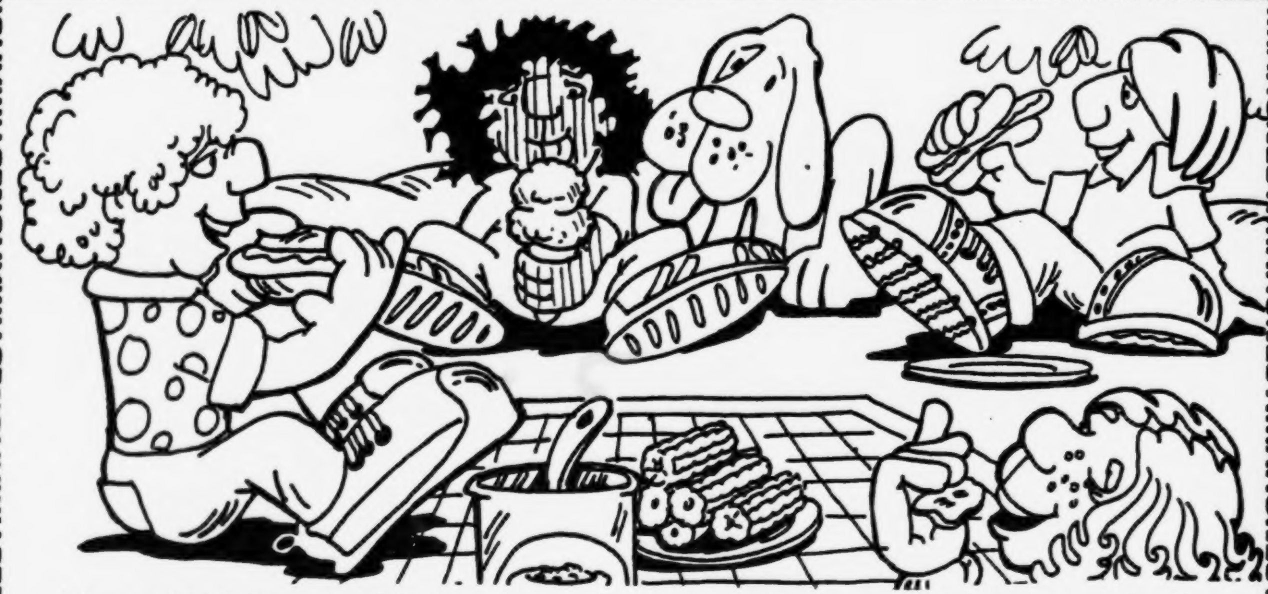
COSTS OF A CLASS PICNIC



Your class has decided to have a picnic. There are 30 members in the class. You have decided to buy all of the items and do your own cooking.

1. Make a rough guess as to what the picnic may cost per person. ________
2. Using that estimate, what will the total cost of the picnic be? ________
3. Estimate the **quantity** of each item you will have to buy.

   hot dogs ________
   buns ________
   mustard ________
   ketchup ________
   napkins ________
   ears of corn ________
   paper plates ________
   baked beans ________
   cola ________
   potato chips ________
   ice cream ________
   cookies ________

4. Estimate the **total cost** for that quantity of each item.

   hot dogs ________
   buns ________
   mustard ________
   ketchup ________
   napkins ________
   ears of corn ________
   paper plates ________
   baked beans ________
   cola ________
   potato chips ________
   ice cream ________
   cookies ________

5. What is the total estimated cost of the picnic? ________

Compare your total cost estimate with your answer to question 2 above. Then compare your estimates with your classmates.

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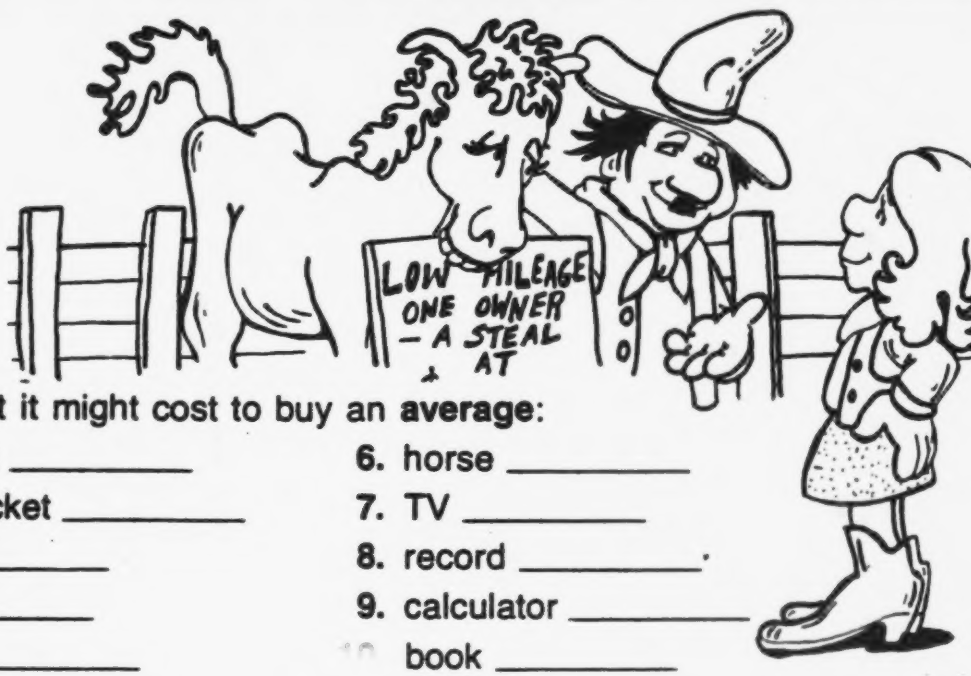
TIONESTIMATIONESTIMATIONESTIMATION ____________________ ESTIMA

estimationestimationestimationestimationestimationestimationestimationestimationestimationestimationestimationestimation

WHAT'S THE PRICE?

estimationestimationestimationestimationestimationestimationestimationestimationestimationestimationestimationestimation



Estimate what it might cost to buy an **average**:

1. soft drink __________
2. tennis racket __________
3. bike __________
4. car __________
5. house __________
6. horse __________
7. TV __________
8. record __________
9. calculator __________
10. book __________

What one thing would you buy if you had:

11. 1 cent ______________________________
12. 10 cents ______________________________
13. 1 dollar ______________________________
14. 10 dollars ______________________________
15. 100 dollars ______________________________
16. 1,000 dollars ______________________________
17. 10,000 dollars ______________________________
18. 100,000 dollars ______________________________
19. 1,000,000 dollars ______________________________

How long would it take an **average** employed adult to earn:

20. 1 dollar __________
21. 10 dollars __________
22. 100 dollars __________
23. 1,000 dollars __________
24. 10,000 dollars __________
25. 100,000 dollars __________
26. 1,000,000 dollars __________

Compare your estimates with your classmates.

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1289

OPINION POLL

WHO IS YOUR FAVORITE POLL TAKER WITHIN A FIVE FOOT RADIUS?
POLL
OPINION
POLL
OPINION
POLL
POLL

When you take a national opinion poll, you can't talk to everyone in the country, so you go to a small **representative** sample of the population. You hope the answers are representative — the same ones you would get if you could ask everybody.

Try giving this opinion poll. Use your class as the sample population. Tally the answers. Look for the favorites. When you have the results, discuss whether or not they are representative of a larger population, local or national.

<table>
<tr><th colspan="6">Name Your Favorite</th></tr>
<tr><td colspan="2">1. TV program</td><td colspan="2">2. male TV actor</td><td colspan="2">3. female TV actress</td></tr>
<tr><td colspan="2">4. movie</td><td colspan="2">5. male movie star</td><td colspan="2">6. female movie star</td></tr>
<tr><td colspan="2">7. female singer</td><td colspan="2">8. male singer</td><td colspan="2">9. rock group</td></tr>
<tr><td colspan="2">10. record</td><td colspan="2">11. food</td><td colspan="2">12. soft drink</td></tr>
<tr><td colspan="2">13. color</td><td colspan="2">14. number</td><td colspan="2">15. car</td></tr>
<tr><td colspan="2">16. brand of jeans</td><td colspan="2">17. brand of shoes</td><td colspan="2">18. football player</td></tr>
<tr><td colspan="2">19. baseball player</td><td colspan="2">20. tennis player</td><td colspan="2">21. basketball player</td></tr>
<tr><td colspan="3">22. pro football team</td><td colspan="3">23. college football team</td></tr>
<tr><td colspan="3">24. spectator sport</td><td colspan="3">25. participant sport</td></tr>
</table>

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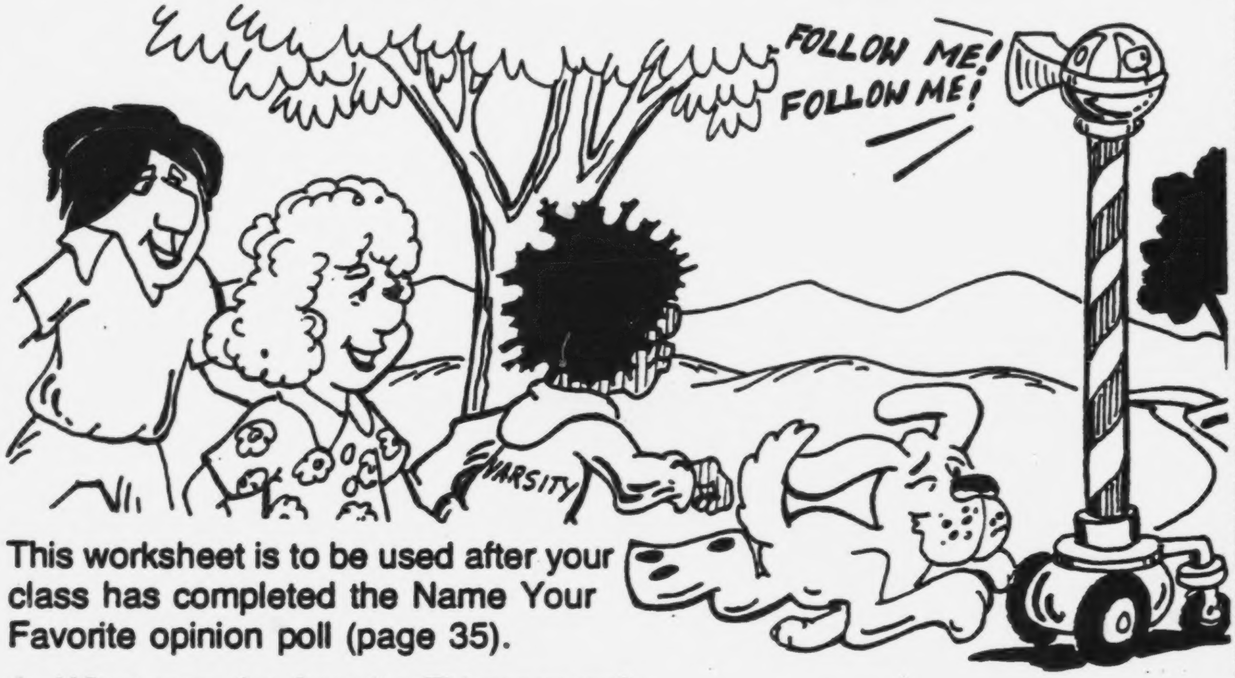
OPINION POLL FOLLOW-UP


FOLLOW ME!
FOLLOW ME!
VARSITY

This worksheet is to be used after your class has completed the Name Your Favorite opinion poll (page 35).

1. What was the favorite TV program? ______________
2. The top TV program received ______ out of ______ total votes.
3. What percent of your class voted for the top program? ______
4. Do you think the same proportion of people in your city will vote as your class did? ______ Why or why not? ______________
5. Would this program receive about the same percentage vote in a national opinion survey? ______ Why or why not? ______________
6. Is the favorite program representative only of your age group, or is it representative of all age groups? ______________
7. Assuming your class sample to be representative, how many people in a city of 200,000 would you expect to:
   a. have blue as a favorite color? ______
   b. have 7 as a favorite number? ______
8. Discuss which of your classes' favorites in the opinion poll are local favorites or national favorites.

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GUESS, MORE OR LESS

MORE FOR LESS DOG CHOW
?
MORE
LESS

Are you aware of quantities in the world around you? This quiz will reveal how aware you really are.

Decide whether each quantity is greater or smaller than the figure given. Some may be easy for you, some difficult. If you don't know, guess. Circle MORE or LESS.

1. Pages in your mathematics book: 400 MORE LESS
2. Classrooms in your school: 25 MORE LESS
3. Teachers in your school: 50 MORE LESS
4. Student lockers in your school: 750 MORE LESS
5. Prime numbers less than 100: 30 MORE LESS
6. Days in your school year: 200 MORE LESS
7. Square feet of glass in classroom: 100 MORE LESS
8. Width of the school hallway: 10 feet MORE LESS
9. Height of school hallway: 8 feet MORE LESS
10. Population of your state: 7 million MORE LESS
11. Cost of your English textbook: $5 MORE LESS
12. Members in the school band: 60 MORE LESS
13. Students in your school: 1,000 MORE LESS
14. Students in your math class with February birthdays: 4 MORE LESS

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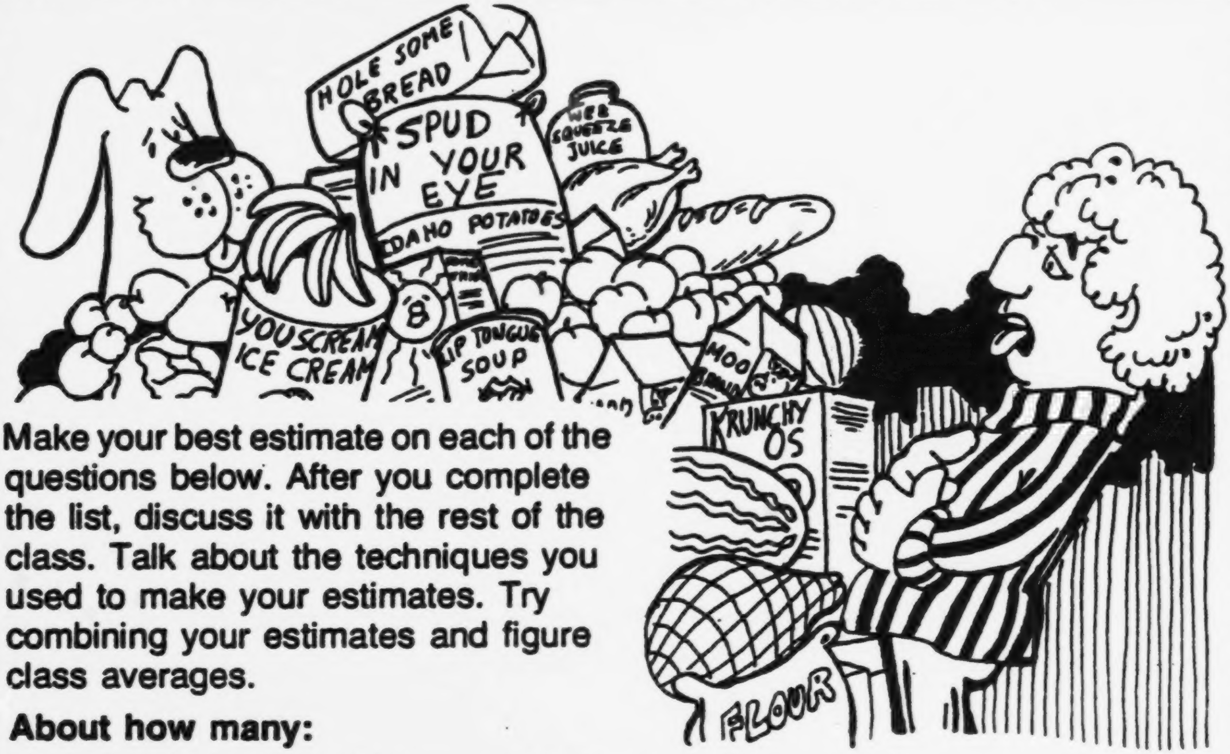
COMPARE WITH THE CLASS


HOLE SOME BREAD
SPUD IN YOUR EYE
IDAHO POTATOES
WEE SQUEEZE JUICE
YOU SCREAM ICE CREAM
8
LIP TONGUE SOUP
MOO
KRUNCHY OS
FLOUR

Make your best estimate on each of the questions below. After you complete the list, discuss it with the rest of the class. Talk about the techniques you used to make your estimates. Try combining your estimates and figure class averages.

About how many:

1. pounds of food did you eat in the past 12 months? ________
2. times have you turned off a TV set? ________
3. doors have you opened this year? ________
4. times you have fallen asleep this month? ________
5. Christmas trees have you helped to decorate? ________
6. books have you read in your lifetime? ________
7. times have you gone swimming? ________
8. times have you worn a necktie? ________
9. times have you looked at a clock this year? ________
10. times have you shot a basketball? ________
11. apples have you eaten in the past year? ________
12. blocks do you live from school? ________
13. times have you swung a baseball bat? ________
14. times have you ridden a bike? ________
15. hamburgers do you eat in a year? ________
16. times have you taken a step? ________

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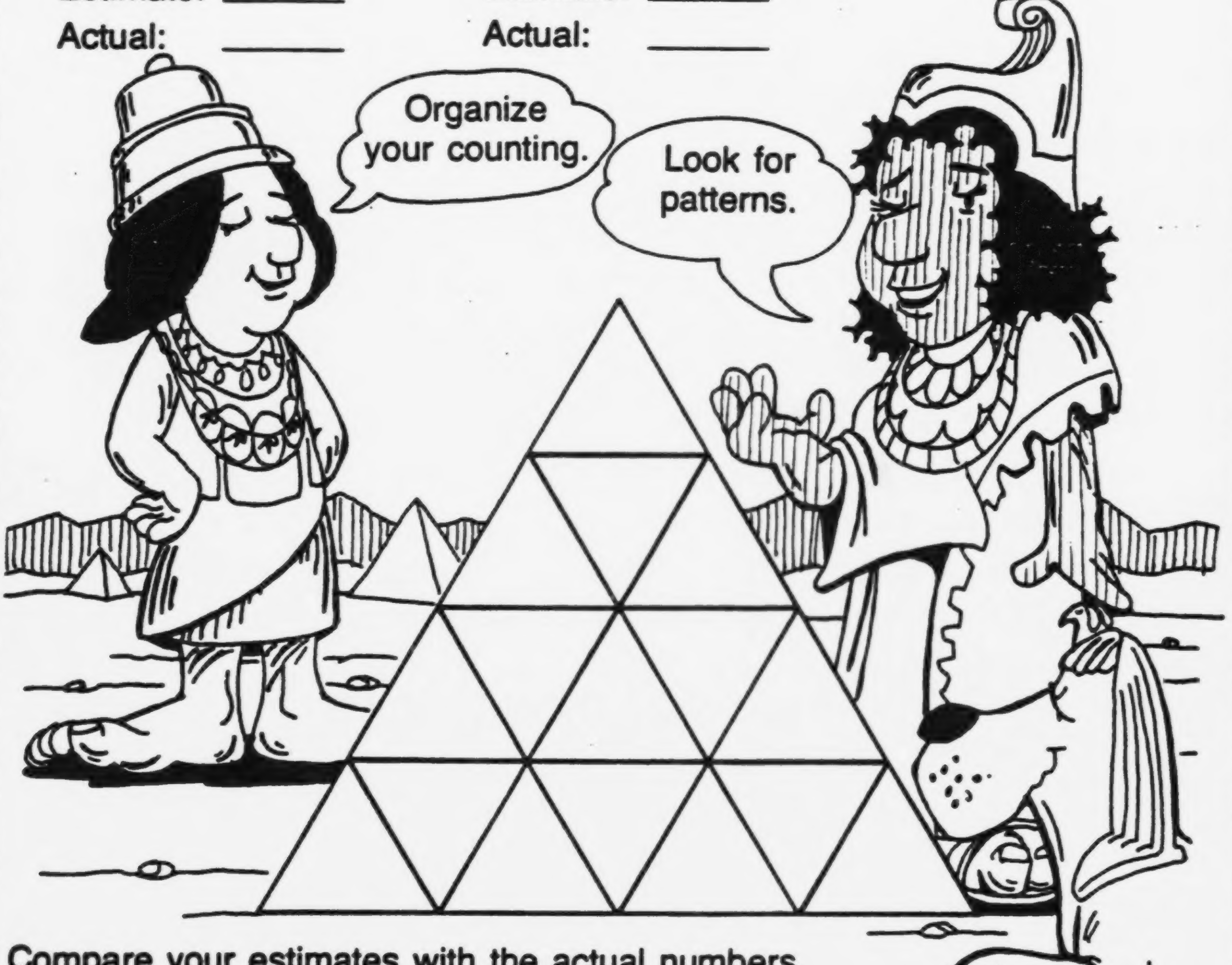
ESTIMATE, THEN COUNT

How many triangles, line segments, angles, trapezoids, and parallelograms are in the figure below?

First make all five estimates. Then count to find the actual numbers.

1. TRIANGLES
   Estimate: ______
   Actual: ______
2. LINE SEGMENTS
   Estimate: ______
   Actual: ______
3. ANGLES
   Estimate: ______
   Actual: ______
4. TRAPEZOIDS
   Estimate: ______
   Actual: ______
5. PARALLELOGRAMS
   Estimate: ______
   Actual: ______


Organize your counting.
Look for patterns.

Compare your estimates with the actual numbers.
Rate your estimation ability.

Great! Average I need more practice!

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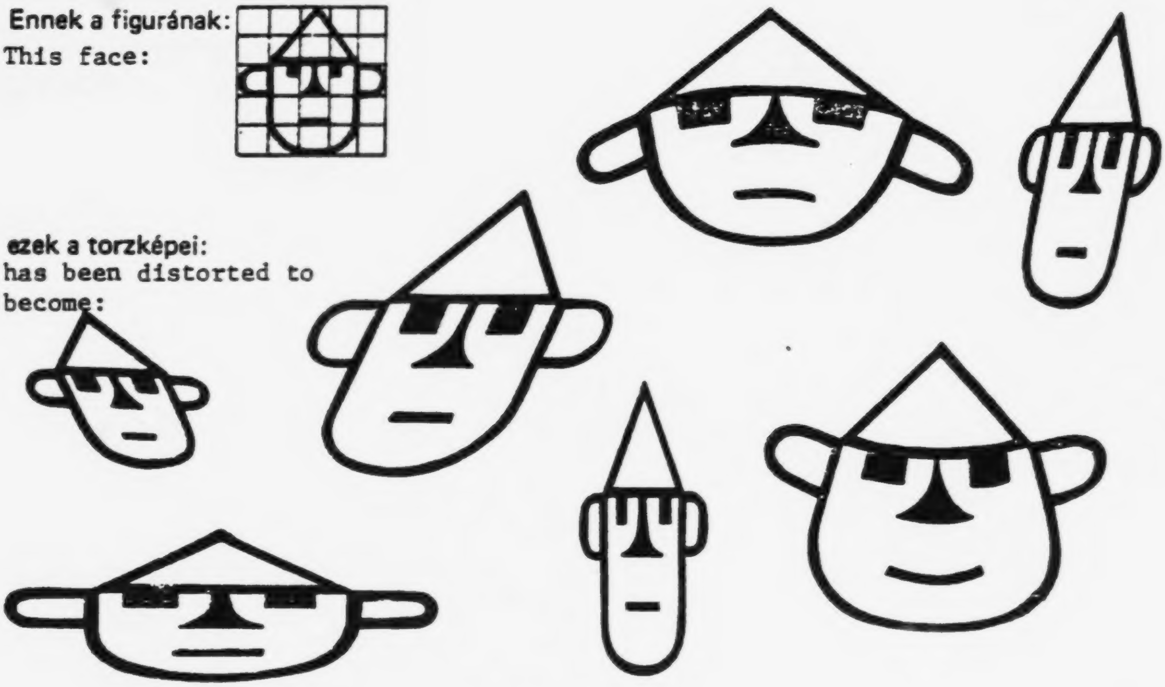
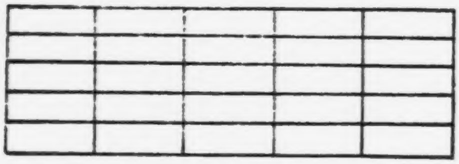
1. Ennek a figurának:
This face:



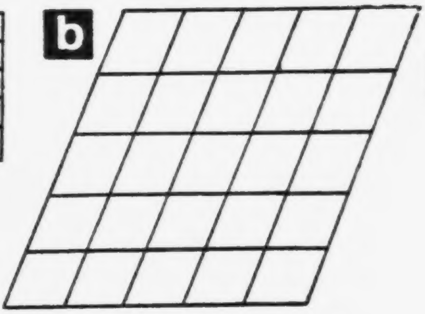
ezek a torzképei:
has been distorted to become:

Melyik hálóval készítettük az egyes torzképeket? Írd a képek mellé a megfelelő háló betűjét!
Which grids were used to prepare each of the distorted pictures?

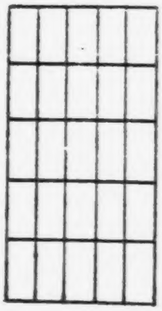
a



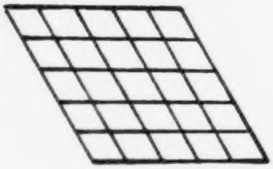
b



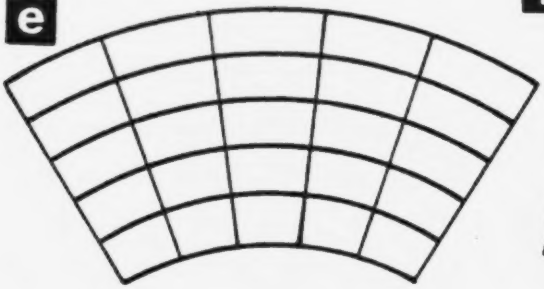
c



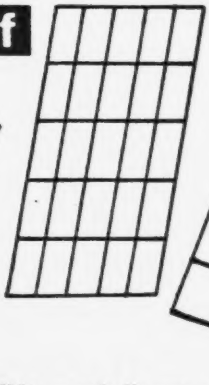
d



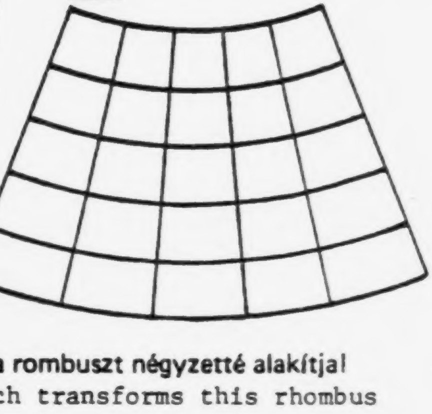
e



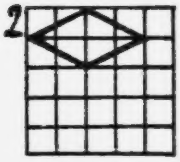
f



g



2

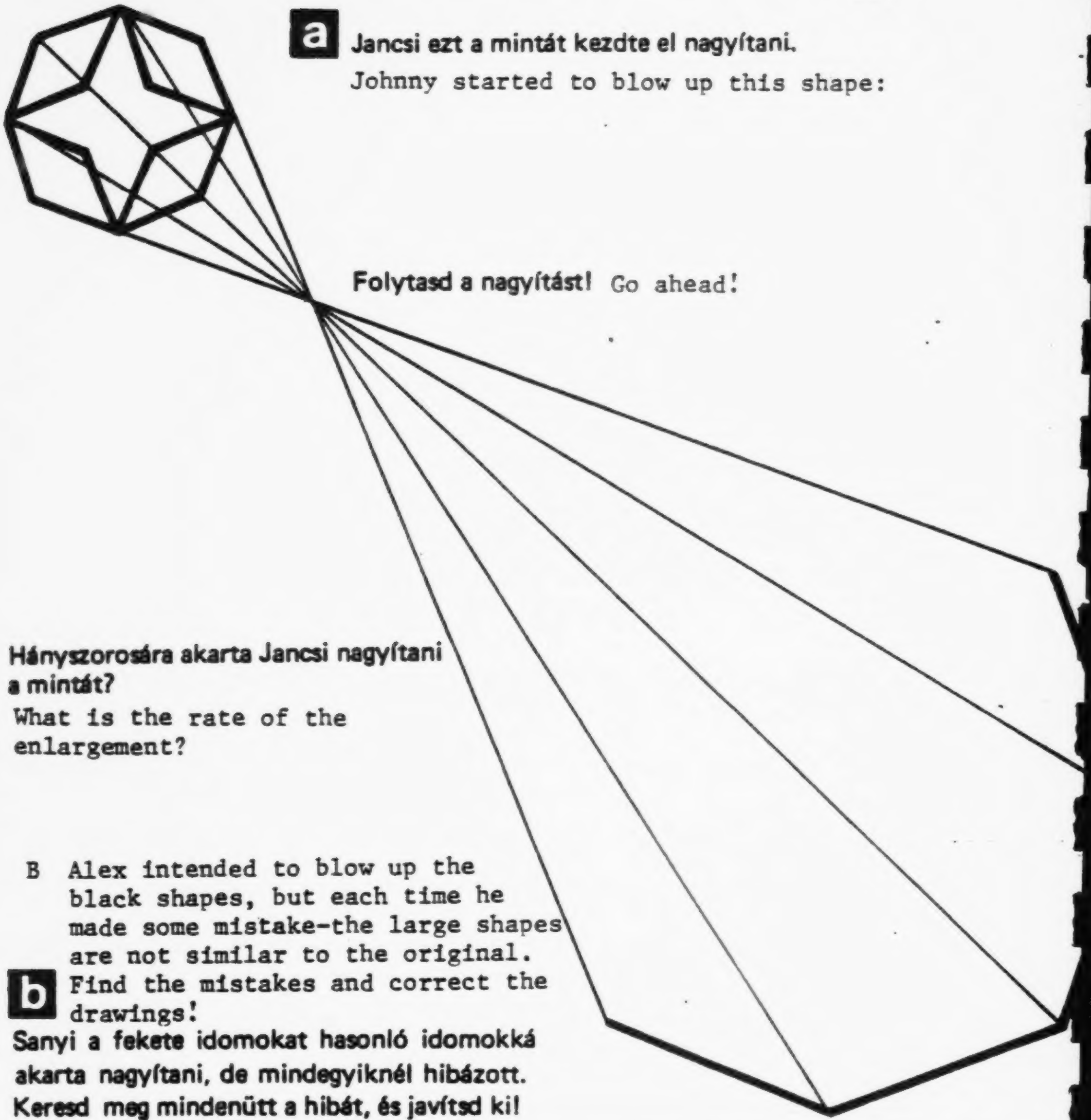


Írd ide annak a hálónak a betűjét, amelyik ezt a rombuszt négyzetté alakítja!
Write down the letter of the grid which transforms this rhombus into a square.

1295

a **Jancsi ezt a mintát kezdte el nagyítani.**

Johnny started to blow up this shape:



Folytasd a nagyítást! Go ahead!

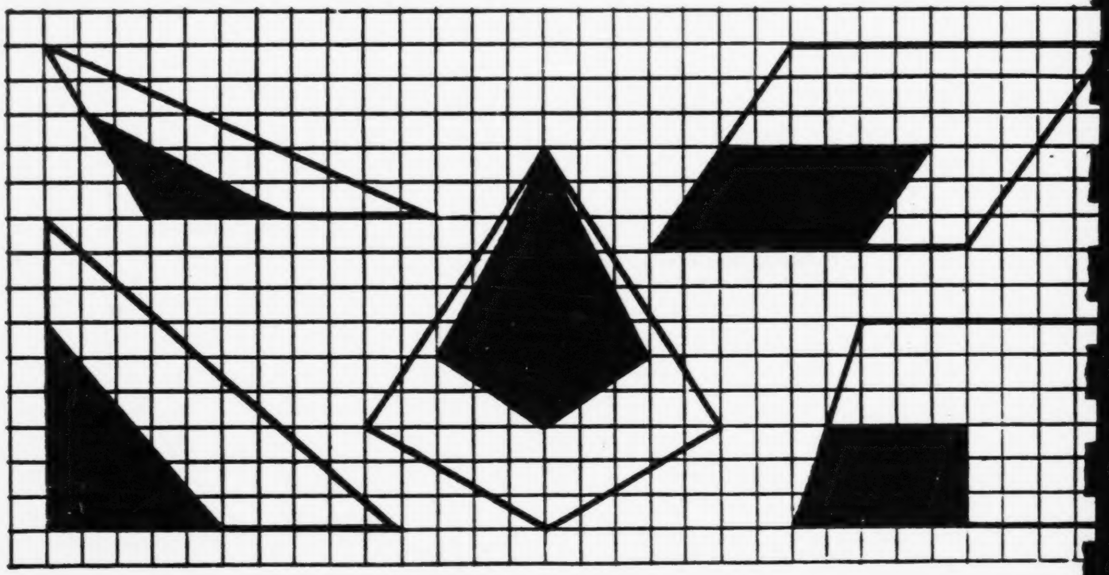
Hányszorosára akarta Jancsi nagyítani a mintát?

What is the rate of the enlargement?

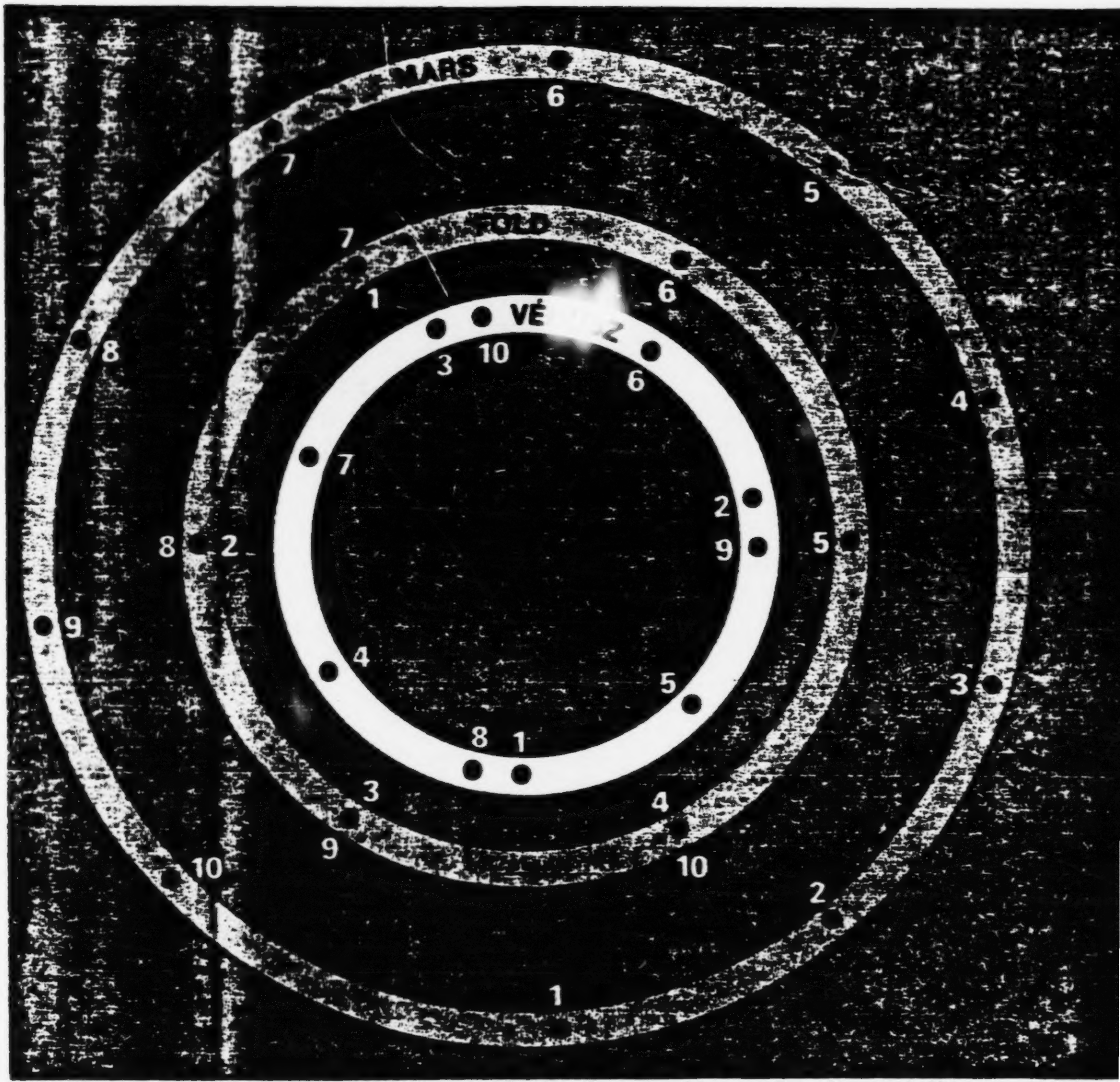
B Alex intended to blow up the black shapes, but each time he made some mistake-the large shapes are not similar to the original. Find the mistakes and correct the drawings!

b

Sanyi a fekete idomokat hasonló idomokká akarta nagyítani, de mindegyiknél hibázott. Keresd meg mindenütt a hibát, és javítsd ki!



Hogyan változik a Mars és a Föld távolsága? Hogyan változik a Vénusz és a Föld távolsága?
A rajzon 10 időpontban jelöltük a három bolygó helyét. 1-essel jelöltük a bolygók helyét az első megfigyeléskor, 2-essel jelöltük a bolygók helyét a második megfigyeléskor és így tovább.



Equal numbers indicate positions of theplanets Mars, Earth, and Venus at the

Mérd meg a rajzon a különböző időpontokban a Föld távolságát a Marstól és a Vénusztól! Írd be az adatokat a táblázatba! (A rajzon 1 cm 32 millió km-t jelent.)

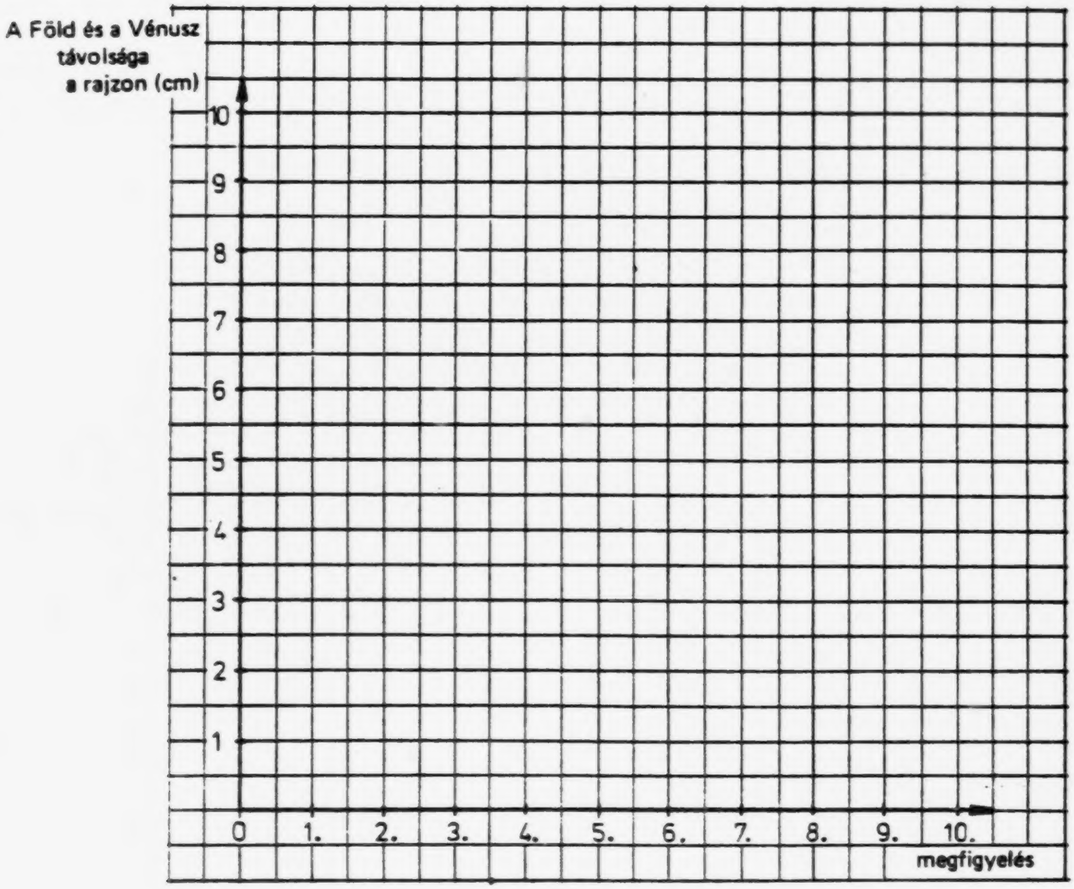
same times. One centimeter on the drawing means 32 million kilometers in real

Fill the table.

A mérések sorszáma Time points	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
Distance Earth-Mars in cm A Föld és a Mars távolsága a rajzon (cm)										
Distance Earth-Mars in km A Föld és a Mars távolsága a valóságban (km)										
Distance Earth-Venus in cm A Föld és a Vénusz távolsága a rajzon (cm)										
Distance Earth-Venus in km A Föld és a Vénusz távolsága a valóságban (km)										

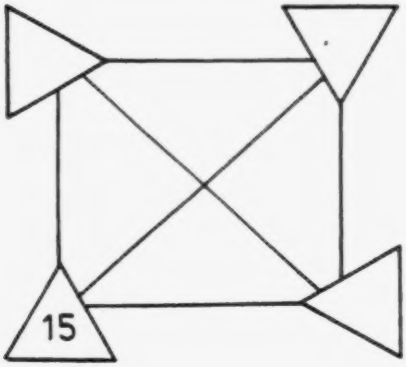
1. Hogyan változik a Vénusz és a Föld távolsága?

Plot the data found on p. 98 - distances: Mars-Earth, Venus-Earth
Ábrázold derékszögű koordináta-rendszerben a 98. oldalon mért adatokat!

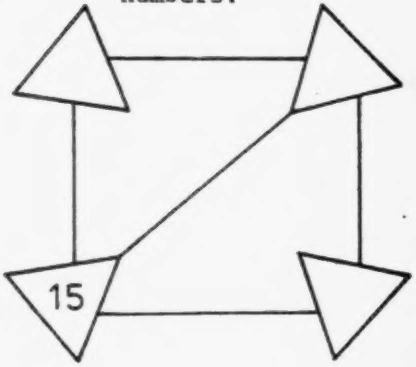


2. Két-két szám közé pontosan annyi vonalat húzunk, ahány közös osztójuk van (az 1 kivételével). Írj minél kisebb számokat az üres keretekbe! The number of connecting lines between 2 frames means the number of common divisors greater than 1.

a Fill the empty frames with the possible small numbers.



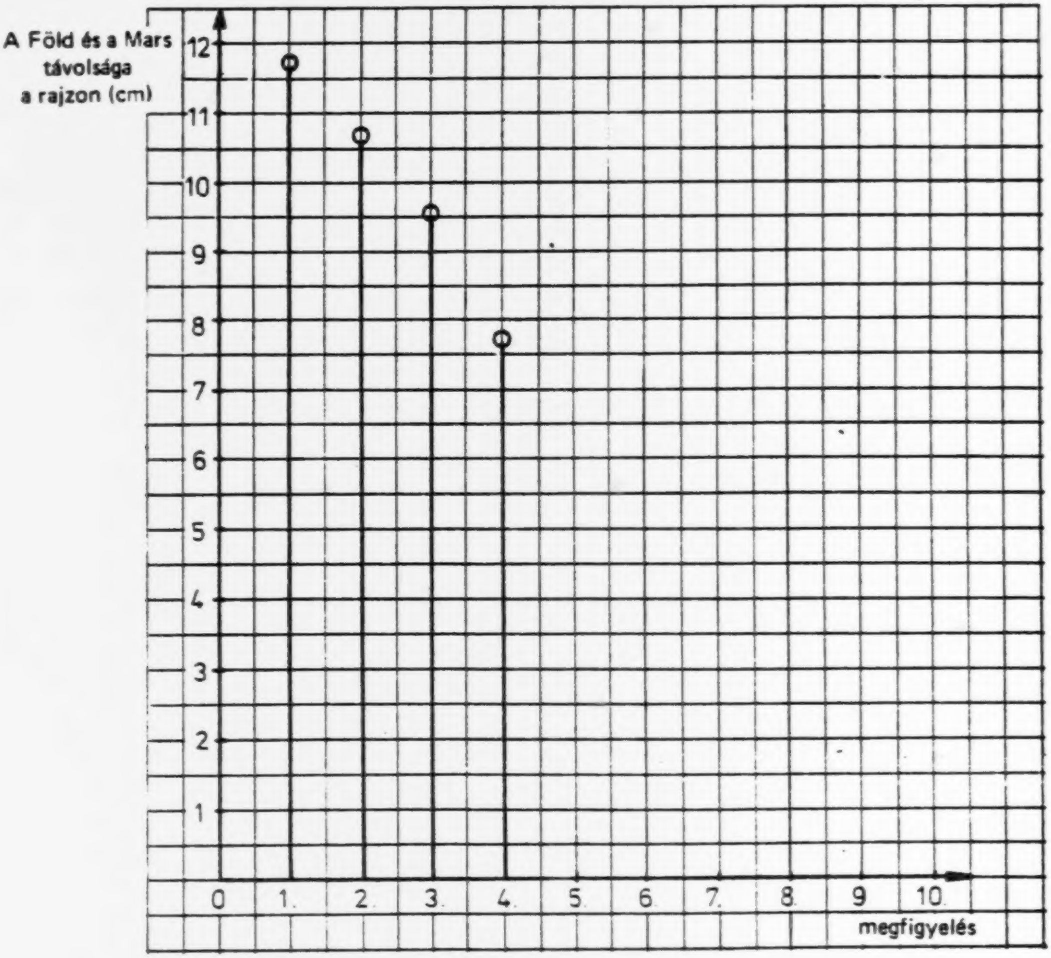
b Fill the empty frames with the possible small numbers.



1. Hogyan változik a Mars és a Föld távolsága?

Ábrázold derékszögű koordináta-rendszerben a 98. oldalon mért adatokat!

Plot the data found on p. 98 - distances: Mars-Earth, Venus-Ea



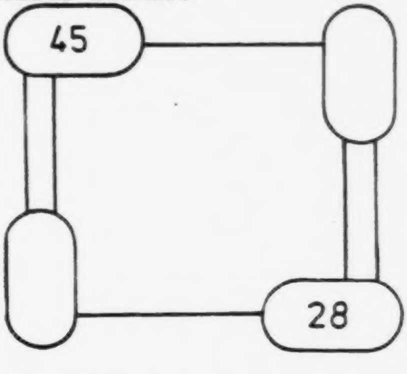
2. Két-két szám közé pontosan annyi vonalat húzunk, ahány közös osztójuk van (az 1 kivételével).

The number of connecting lines between 2 frames means the number of common divisors greater than 1.

a

Irj minél kisebb számokat az üres keretekbe!

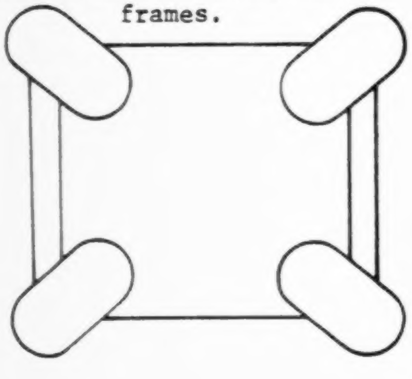
Fill the empty frames with the possible small numbers



b

Helyezd el ezeket a számokat a keretekbe: 99; 117; 44; 52.

Place these numbers in the frames.



Draw, each on its own branch,
a King with a crown, on the topmost branch
a Clown on the next branch down
then a Doll
a Bear
and a Cat on the lowest branch.

Ask your child such questions as the following:

'Who is at the top of the tree?' (Answer: King)
'Is there anyone higher than the King?' (No.)
'Who's on the lowest branch?' (Cat.)
'Is anyone lower than the Cat?' (No.)
'Who is higher than the Bear?' (Doll, Clown, King, all are.)
'Who's lower than the Doll?' (Bear and Cat.)
'Who's next higher than the lowest?' (Bear.)
'Who's next below the King?' (Clown.)
'How many people are higher than the Clown?' (One, the King.)
'Are there any lower than the Bear?' (Yes, the Cat.)

These questions proceed from the general (such as when we talk of higher or lower branches) to the particular (such as when we talk of the next higher or next lower branches). As we have mentioned, this fits in with a child's learning pattern.

The Clothes-Line Game

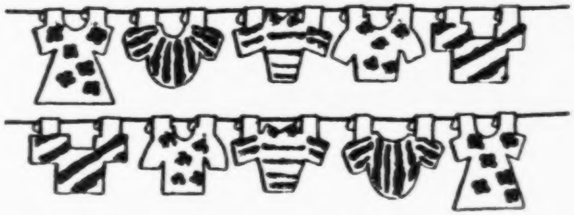
4 + years An ordering game, with girls in mind.

Things needed. Ask your girl to draw, color and cut out paper dresses, like those printed in children's magazines and books for dressing up paper dolls. Two copies of each paper dress are needed.

Fix up two tiny clothes-lines in the form of strings hitched between two chairs. Suggest your girl hangs the clothes up to dry. She can use paper clips or bend over paper tags attached to the paper dresses.

The game. Put the clothes in some order – maybe from brightest to least bright, from favourite to least favourite and so on. The rule for the order does not matter, just so long as there is one. Now she should set up another, identical clothes-line so that the clothes on each line match up. Matching-up is vitally important to a child's understanding of number at this stage of learning.

She should reverse the order of the clothes on one clothes-line only. She may have to make several attempts before she understands what this entails.



Then she should reverse the order of the clothes on the so far unaltered line. She may realize that both clothes exhibit the same order again.

Should a child take the game seriously enough to want to wash the paper clothes, enter into the spirit of the thing and draw a wash bowl with 'pretend' or 'make-up' water in which she can 'wash' them.

Suppose there are an odd number of clothes – say, 5 or 7 on each clothes-line. Then when the child reverses the order of one clothes-line, the middle dresses will continue to match up. If your child notices this, encourage her observation quietly. Suggest she make up a clothes-line without a middle dress. Finding a solution to this problem could represent a child's very first piece of mathematical research!

For your own information. There's always a 'middleman' for an odd number of clothes – 3, 5, 7, 9 and so on; but never one for an even number – 2, 4, 6, 8 and so on. Try it and see for yourself. But don't tell a child.

Animal Grab

4 to 5 years *Things needed.* Pictures of animals from newspapers and magazines. Stick the cuttings on light card to make playing cards. More than one copy of some pictures provides an opportunity to play Snap.

Play. Ask your child to arrange the animal cards in order of size of the animal. For instance, you might have pictures of a rabbit, dog, bear and tiger (in that order). A problem is likely to arise if the pictures are not all much the same size, as they are likely to be. The child may, rightly, want to order the pictures by their actual sizes. Thus a giant photo of a rabbit will be classed as bigger than a postage stamp portrait of an elephant. The solution is simply to agree on your ground rules before you start. Try these versions:

Any bigger animal 'takes' a smaller

The *next* bigger animal wins
A fiercer animal takes a more timid one.

Once an order of fierceness has been agreed, all players must keep to it.

Other cards and orders you can play are

People – put them in order of size
Aeroplanes – order by size
Cars – order of size or speed
Pets – order of popularity.

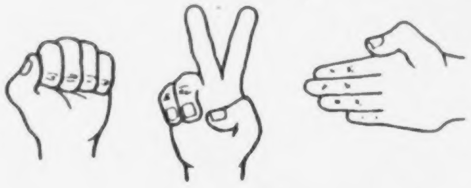
Stone, Scissors and Paper

4 to 5 years A modern variation on the old game.

Things needed. Grab bag
Colored counters or tiddlywinks
Ludo board.

The old game, you may recall, goes like this. Two players face each other. At a given signal – a nod or one of them counting 'one, two, three' – each makes one of three signs with his fingers:

clenched fist to indicate 'stone'
first two fingers outstretched for 'scissors'
flat of hand for 'paper'.



SET 7 Ordering Games

Order to rule. 'Goldilocks and the Three Bears' is a story of orderliness in a child's world. The order in it is based on a rule of size – biggest first, smallest last: big bear, mother bear and baby bear each with matching porridge bowl, chair and bed. The apple-pie system recalls the well-ordered fantasies of the mathematician's mind. It also reminds one that the mathematician's world is quite close to children's rule-bound games. The first order-to-rule a child encounters is probably the A–B–C order of the alphabet and the 1–2–3 order of counting.

It is worth re-emphasizing that orders need not be rule-bound. The arbitrariness of order in math is rarely evident to the child even if he is able to count. In putting the Three Bears into an order, it would be natural to rank the Big Bear first; but equally reasonable to place the Baby Bear first – or Mother Bear!

There is a subtler side to order: if the winner of a horse race is disqualified on some count, there is still a first horse to take his place. Children find this aspect hard to conceive. They do not realize that order numbers (first, second, third, and so on) are different from counting numbers. This may be why the job of looking up words in a dictionary presents children with problems.

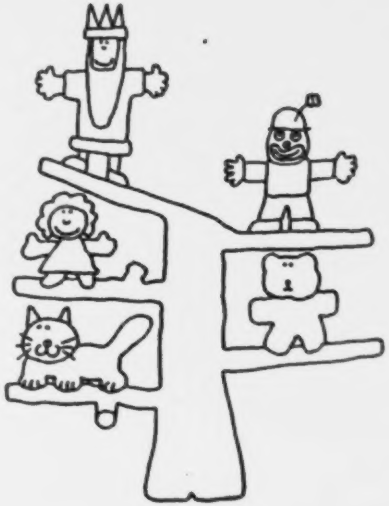
On the whole, a child has to cope with ordering problems as best he can. Little formal training in ordering is given in schools. Yet with a little ingenuity it would be possible to turn everyday ordering situations into thought-provoking problems. Take, for instance, the rule about children filing out of a classroom. 'Smallest children leave first, tallest last' is such a rule. One could make the situation more interesting by adding a second 'ladies first' rule: when two children of the same height arrive together at the classroom door, the girl leaves first. Deciding on the order of their going requires considerable thought. We have not included such double-ordering games because they are too involved for infants to cope with.

King of the Castle

4+ years

A pencil-and-paper ordering game.

Draw a tree for your child or better get him to draw one. Draw it with four or five big branches drawn as uncomplicatedly as possible, one above the other.



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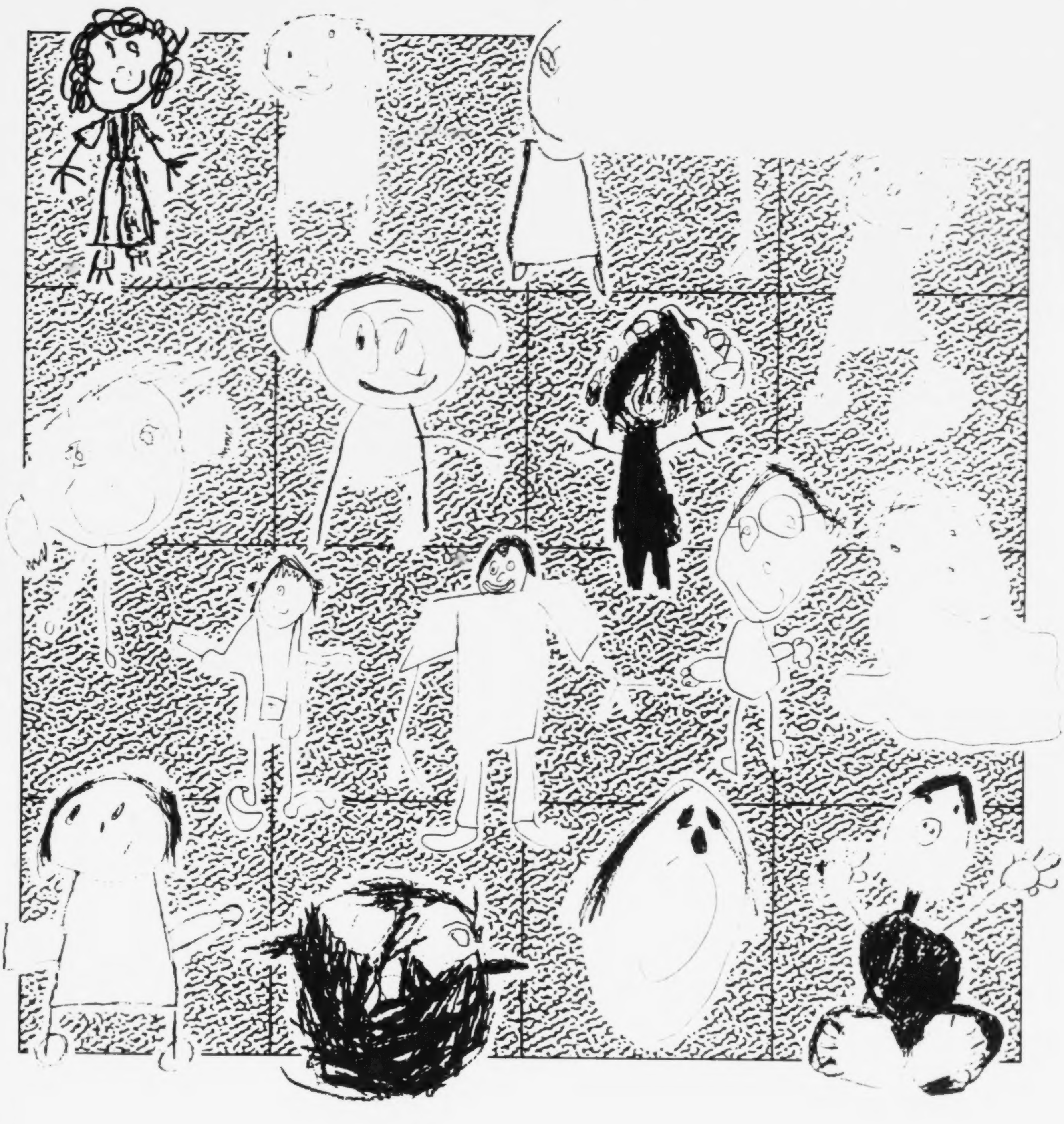

SEEDBED

1307

SEEDBED

NUMBER 14

by Helen L. Miller

January, 1983

Teachers' Center Project

SIUE

**Southern Illinois University
at Edwardsville**

1308

INTRODUCTION

Those of you who know Helen Miller will need no further introduction. Here is Helen in her work.

Those of you who haven't met Helen will get to know her here. But first a word of introduction. Helen Miller is five feet nothing. She's made of pure energy. She's one of the most able, well-read, gifted, thoughtful, searching, caring teachers I have met. To say it simply, Helen is on fire about the well-being of children. As such, she is a welcome ally--and, in fact, leader--in the work of the Teachers' Center Project.

As I was beginning to write this introduction, Shirley Casey said, "Tom, be sure to say how Helen got that way." "Cripes, Shirley, what can I say--good genes?" "No," said Shirley, "Think back to what Helen went through; it's a model for others."

There are two aspects to Helen's career, as I have known it through the Teachers' Centers: attitude and professionalism. Helen's attitude is, foremost, caring. It leads to an honest questioning of the procedures schools so often automatically follow. Much of what we do in schools, however well-intentioned, is mindless.

But such an attitude can be a dead end. "I care and I think things can be better," needs a next step and here's where Helen's professionalism comes in. Helen read and read and found that she had friends and shoulders to build on. The works of Jean Piaget and his collaborators and critics opened up for her alternatives to what, in many cases, are barren educational practices. The next step was childwatching--"How do my children see the world? What sense (or nonsense) do they make of it? What is the effect of what I do with children in the classroom? How do they learn?

How am I a part of that learning?"

The long and short of the issue is that Helen found shoulders to build on and in this SEEDBED she is, herself, a shoulder to build on.

We are immensely delighted to make available Helen's thoughts. And we invite readers to extend and bend her ideas as we work together on behalf of the well-being of children.

Thomas C. O'Brien

Shirley A. Casey

Shirley A. Casey

Edwardsville, Illinois
January 14, 1983

* * * * * * *

ABOUT THE COVER

What is appropriate for the cover of an issue of SEEDBED in which one teacher (Helen Miller in this case) writes about her observations of her kindergarten students? It has to be the way in which those same children see her. That's just what appears on the cover of SEEDBED 14--a collection of Helen's students' portraits of their teacher.

If, by chance, you're ever fostered the notion that all children see the same thing in the same way, just take a closer look at those drawings.

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ANGIE
ARUHHWH

Sharing

"Children, share your toys!"

"Boys, if you are going to play together, you must share the blocks."

"Johnny, will you share with Jim?"

"Mary, share the candy with your cousin."

"Joe, Jamie is crying. He said you would not share the balloons with him."

Typical admonitions such as these express conscious, or perhaps, unconscious rules for acceptable adult social interaction. Adults assume that children will accede to the warning laid down by the adult authority because every human being understands that "sharing" means to divide as equally as possible the total amount of items among the participating members of a group.

Do preoperational children comprehend the meaning of "sharing" in a way that an adult does? A young child's thinking is egocentric, his perception of the world is global. What do small children understand the act of "sharing" to mean?

Two small boys have a box of dominoes and are getting ready to play a game.

Teacher: Boys, do you have to share the dominoes to play the game?

Both boys nod their heads affirming the necessity to share.

Teacher: What is sharing?

Scott: Everybody has some.

The tiles have been distributed by Scott. He has given nine to the teacher, eleven to himself, and seven to Jason. After Scott has portioned out the tiles, he uses his to make a design rather than to play a game. Quite unexpectedly, Scott looks at Jason and at the teacher and declares:

Scott: He's not sharing.

Teacher: Scott, you gave them out. Why don't you think Jason is not sharing?

Jason has a rather perplexed look on his face.

Scott: I need something all around. He won't give me none.

Scott has used his dominoes to make a design. Having used all the tiles he had given himself, he does not have enough to complete the design.

Teacher: Jason, is Scott sharing?

Jason says nothing, but shakes his head, yes.

Teacher: Let's start again. Jason, will you do the sharing this time?

Jason: I'm sharing.

Jason puts all the dominoes in one pile and deals them out, one by one. Everybody has an equal amount.

Teacher: Is this sharing?

Jason: Yes.

Teacher: Would counting tell us we are sharing?

Jason and Scott both shake their heads and emphatically say, "No".

Teacher: How do I know that we are sharing?

Scott: Just by sharing!

Teacher: Scott, tell me again what sharing is?

Scott: Ask Dad when he comes.

Once again the boys decide to start the game over. All the tiles are again placed in the middle of the table. This time Scott is the one who disperses the tiles to each player. Scott gives himself seven tiles, Jason is granted a total of eleven tiles, and the teacher receives ten. The total amount has never been determined; it does not seem to be relevant to sharing.

Teacher: I'm still not sure what sharing means. How do I know that we are sharing?

Scott: (Rather startled by the teacher's inability to comprehend the obvious.) By looking!

Teacher: How will looking tell me?

Scott: It's in your brain. Your brain goes 'click-click'.

Teacher: Scott, I don't hear a 'click-click'.

Scott: Because it's not on.

Teacher: (Seemingly very intent on activating her brain.) I still don't hear a 'click-click'.

Scott: (Referring to other noises in the room.) Somebody's doing something.

Teacher: May I take a turn to share now?

Scott: I guess. (Said in a rather resolute manner.)

The teacher retrieves all the tiles and then gives one to Scott and one to Jason. All the remaining tiles are in front of the teacher. Jason watches pensively. Both boys seem a bit perplexed at first and a bit disgruntled by the result of the teacher's "sharing". Neither boy says a word.

Teacher: Is this sharing?

Scott: (Said without reservation.) Yes.

Jason: Yes.

Scott: We don't have very much. (Expressed somewhat stoically.)

Teacher: Is this a good way to share?

Scott: Yes.

Jason says nothing, but he seems to be in agreement.

Scott: (Turning to Jason) Let's build something. The two boys combine their assets and try to create something with a total of two dominoes.

****

Three boys decide to play a game using metal washers (painted various colors) piled in the center of a table.

Teacher: Boys, are you going to share the washers when you play your game?

All: Yeh!

Teacher: How are you going to share them?

Jamie: You just take a couple.

Teacher: If you use all the washers, can you share?

All of the boys instantly dive for as many washers as they can retrieve from the pile.

Teacher: Is that sharing?

All of the boys push their washers back to the center of the table.

Teacher: How many will you each have if you share them?

Shane: Everybody has some.

Jamie: Enough.

Teacher: Would counting tell you that you have shared?

Shane: 'Cause we got two at a time.

Teacher: Does everyone have to have some if you are sharing?

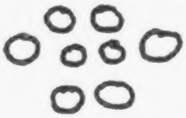
Shane: Stack 'em to see.

Shane recounts his washers and then compares his group to Steve's by employing one-to-one correspondence. As Shane is talking, he surreptitiously slides a washer toward Steve, as though he were correcting an injustice prior to discovery.

Teacher: Shane, why did you give that washer to Steve?

Shane: 'Cause that was his.

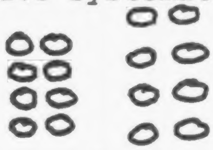
Steve in the interim has arranged his washers in the following way:



Teacher: Can we tell that the washers are shared now?

Shane: Each has two.

Shane and Jamie have systematized their washers in the following manner:



Teacher: I see two and two and two and two. How many washers are there in front of Shane?

Shane has ordered his washers by two's, but when asked to verbalize the total amount, he touches and counts the washers individually.

Shane: 1,2,3,4,5,6,7,8.

Teacher: Jamie, tell me about your pile.

Jamie: Shane has more.

Shane: (Adamantly)....same size!

The group now becomes very engrossed in counting. Each child quantifies the number of washers he has received. In order to determine the total amount of washers on the table, the boys find that they will need to use the beadstring. The sharing problem has evolved into an addition problem.

****

For the preoperational children who participated in these activities, the words, "some" and "enough" represented a mutually acceptable definition of the amount one needed to receive if "sharing" were a prerequisite of the game. The "sharing" was dependent upon individual satisfaction. It seems to be a flexible and arbitrary division, ancillary to the game and the needs of the participants.

Adult admonitions to "share" are adhered to by most young children, but is their compliance merely a superficial one? As the children interact with peers the necessity to "share" seems to evolve in a manner that matches each child's developmental level of reasoning. "Sharing" is a concept which is evolved, not one which is dependent on an edict issued by the adult authority.

As children become more cognizant of numerical values and of ways in which numerical concepts can be utilized, they will share in a more mature manner.

"Sharing" imposed upon children by the adult authority will accomplish immediate equality of amount, but will it keep a child's understanding of the moral value of "sharing"? The answer is no.

Constance Kamii has stated in the May, 1981 issue of Young Children that "autonomy is not only more moral than heteronomy; it is also more intelligent than heteronomy. Autonomy, in other words, is indissociably moral, intellectual, social, and emotional in nature."

Piaget's research shows moral values to be constructions from within. If "enough" and "some" are sufficient amounts for young children, so be it! What adults can do is to strive to provide opportunities that will facilitate "sharing". With maturity will come a truly meaningful need to share in a way that is equitable.

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JerrSY
HoimeS

A Parent Inquired and I Replied...
HOW, WHAT, WHERE, WHEN and WHY

Prerequisite:

1. Immutable belief that learning is a process of construction from within the individual.
2. Firm foundation of knowledge concerning the characteristics of the children at level you will teach.
3. Ability to relinquish the authoritarian role and to assume the role of facilitator and learner.
4. Strong support system - The Teacher's Center Project- for sharing, caring, and swearing.

Why:

1. All children will achieve.
2. It makes sense.
3. Learning is a twenty-four hour a day, seven days a week, fifty-two weeks a year experience.
4. Children are free to make mistakes and are motivated to try again. CHILDREN LEARN BY THEIR MISTAKES, NOT THEIR FAILURES.
5. It requires no special equipment or materials.
6. Learning becomes an exciting, meaningful experience for child and teacher.
7. It enables a child to interact with peers and with adults in a realistic manner.
8. It enables a child to explore new ideas, to utilize new concepts, to verify his thinking in a positive way.
9. It enables a child to construct a firm foundation for future learning.

How:

1. Observe, listen, question all children you can legally approach to learn the interests and characteristics of children the level of those you will be teaching. (You have from today until approximately September 1st - so hurry:)!
2. Accumulate all free and available materials which the children in your class might find useful - do NOT buy what you can beg:
    a. home-made balance scale
    b. rocks
    c. containers of all sizes
    d. signs
    e. tickets (baseball, not speeding)
    f. bottle tops
    g. programs
3. Present each teacher who has an adjoining classroom with a pair of ear plugs the first day of school. Or ask each adjoining teacher at what particular time of the day they have to have absolute quiet.
4. Have the courage of your convictions: Welcome all questions about how you are teaching.
5. Meet with parents as soon as possible to explain what you are doing and why. They will understand.
6. Invite parents to participate, but never allow them to come in the classrooom and sit. They, too, will learn by doing.
7. Never give direct, absolute answers, unless the question is, "May I go to the bathroom?"
8. Tie your hands behind your back. The children will only really learn WHEN THEY CAN DO IT THEMSELVES.
9. Be ready to relinquish the role of THE TEACHER.

Autonomy is the rule. It's hard to do, but the rewards for the facilitator of learning are far greater.

10. Don't be discouraged if the children do not immediately become voracious seekers of learning. Remember that this way of learning is a completely new concept, contrary to every imposed rule of conduct in a classroom that they have ever been forced to comply with.
11. After a day of playing games be sure that the children are aware of the purpose of the games. Take time to have them verbalize what concepts they are learning. "What did you do today?";"Nothing, we just played games" does not really impress parents. In fact, rather than use the word "game", call them "learning activities."
12. Send periodic news letters (which can be done entirely by the children) to keep parents informed of what their child is doing and of what the plans are for future activities. Parents are an invaluable resource - or an immutable adversary if they are not kept informed.
13. Share with fellow teachers the "good things" you are doing. They may decide to try some of your ideas; this is the highest testimonial you can receive.
14. Make friends with the custodian. Leave messages to indicate projects which should not be swept away. He will have difficulty differentiating between Johnny's wood chip project and a mess on the floor. The children should also take the responsibility of cleaning up after they are finished. (Hint: It's advantageous to remember the custodian at holiday time and to find out when he is having a birthday.)

15. Be prepared to stay a few extra minutes after school. It is sometimes very hard to persuade the children that it is time to go home!
16. Allow learning in your classroom. Children will always be learning and active. Make it constructive, meaningful learning. Let the children share ideas and answers. They will learn more from each other than they will from you; so facilitate interaction so learning can be a positive experience.

What:

1. Ask the teachers at the next level to give you a written list of what they require students to know. This will give you a general guideline within which to plan. (Teachers whom you ask for this information will tend to be a bit overwhelmed by this request because it is likely that no one has ever asked before.)
2. Listen, observe, and question the children from the first moment that they enter your classroom in the fall. As they interact with their peers, and as you question their thinking, it will become very clear at which level of development they are working.

When:

A child learns a new concept when he is developmentally ready. You will know by the questions that he asks what the next step is to be.

Where:

Inside, outside, all around....When there is a child ready to learn, and an adult who is concerned about that child, learning will evolve..........

Note:

There are items cited above that many constructivists would adamantly object to. I, also, abhor some of the aspects of current educational requirements.

The practices listed above allow a constructivist to survive and to pursue logical educational theories within the system.

kellin
KELL IN

Applied Piaget

The application of Piagetian theories to a classroom situation has been defined in many ways. It is a science; it is an art; it is an individual process; it is a necessity in this age of computers.

The concept of individualized learning to some is an enigma for which there is no solution. In others it engenders visions of chaos and confusion. Some fear individualized learning as a monetary threat. There are teachers who are unwilling to relinquish their role as the authoritarian figure in a classroom.

All these speculations have no factual information to substantiate them. Jean Piaget did not relate his theories to applied education in the public schools, but he gave us guidelines pertinent to applied education. He made it possible for teachers to facilitate education that is meaningful, motivating, and viable for children. He gave us guidelines with which to construct a significant learning environment for children of all cultures and economic levels of society.

The beginnings of an application of Piagetian theories in a classroom may begin without special materials or big federal agents. It does require one to be resolute about making education a meaningful experience for children. It requires the teacher to put aside the scepter of authority and to once again don the cloak of the learner. Materials may be as simple as a piece of string or an interesting rock. The beginning is the moment a child asks a question.

The following may help clarify the differences between direct teaching situations and those which are approached in a heuristic method at the preoperational level of a child's development:

Direct: "Turn to page 15 in your workbook and circle all the items which are heavier."

Heuristic: A simple balance scale is easily accessible to the children to use to compare weights of various objects.

Direct: "Mark all the pictures on your paper that are squares."

Heuristic: The children use peg boards, clay, sticks, etc. "Tell me about the shape that you have made. How many sides does it have?

Direct: "Count the cubes in your tower. Count the cubes in the other tower. Write the number that tells you how many?

Heuristic: "Let's look at the towers you have made. Which one has the most cubes? Can you make them both the same size? Can you make them bigger (smaller)?"

Direct: "Get your workbooks. It is math time."

Heuristic: "John, please take enough cups so that everyone at your table will have one." (More "math" is done at snack time than in a structured math period. This practical application of numbers is not the kind that is forgotten during summer vacation.)

Direct: "Children, put the toys away in the right boxes. The pictures of the right things are on the front of the box."

Heuristic: "Will you put the things that are alike together in the same box." (Children need to classify objects in many different ways. As they interact with their peers they find their reasoning questioned and begin to expand their thinking.)

Direct: "That's a silly answer. Think before you say anything."

Heuristic: "What way did you do the problem? Can you tell me or show me what you were thinking?" (The answer may be incorrect, but the reasoning may be quite good.)

Direct: "John, you must share the marbles. Give Joe three of yours. Then you will each have three to play with."

Heuristic: "How many marbles do you have? What can you do to figure out how many each of you will have to have the same amount?"

Direct: "Teresa, I told you not to scribble."

Heuristic: "Teresa, tell me about what you have written."

Direct: "Mark all the pictures that begin with a "b". (Later: A child's book page is marked wrong because the child marked a picture of a sailor.)

Heuristic: "John, tell me what pictures you marked?" (John points to the sailor and identifies it as a picture of a "BOY".)

Have You Observed A Child's Thinking Today

"Have you hugged your child today?" is a slogan frequently seen on the back bumpers of cars. A similar slogan for educators might be the following: "Have you observed a child's thinking today?"

It is a multifaceted activity which presupposes knowledge of the characteristics of a specific level of a child's development. A prime factor for the acquisition of observational skills is prodigious reading. One must be conversant with a child's developmental capabilities and the manner in which learning is hierarchically constructed.

For the novice observer supportive professional organizations such as the Teachers' Center Project at Southern Illinois University can be invaluable. Every participant is free to express his ideas and concerns. Observations about children's thinking are shared; adult thinking is clarified; ideas are exchanged; and problems become everyone's concern. Discussions among teachers of other levels about children's thinking will increase one's understanding of the hierarchical development of learning.

A major facet in the acquisition of observational skills is the necessity to approach the task as a learner. The role of the authoritarian must be cast aside. Learning about children's thinking is starkly limited if the observer dictates and directs the responses of the child.

The observer must be very positive in his approach. He or she must establish some feeling of trust and security with the child or children being observed. A child's feelings deserve to be respected. Children instinctively sense anxiety or insincerity and will respond in a negative way (or simply not respond at all). If the child is allowed to form his thoughts when being questioned about an activity and allowed to find the words (and actions) with which to answer, the observer will have a much richer response than normally occurs when questioning is rapid. Further, this need not be an activity during which new concepts are taught, nor an activity which should be accelerated. The child sets the pace and the observer listens, questions, and watches for responses. Patience is essential to success.

Language is an integral part of the process of observing. Questions must be as succinct as possible. The questions must be clearly understood by the child. Children have a much larger spoken vocabulary than they have understanding of adult meanings of words. Words can be very deceptive. It is helpful to use manipulatives to enable a child to demonstrate (and develop) his thinking in a tangible form that can be accurately evaluated. There is an aphorism that is wise to remember - "Never Assume!" Approach the problem in several ways. Let the child think it through and try alternative ways to handle the problem.

Give a child thinking room. Repeat questions if necessary. Do not insist on answers. If the child is to find one answer, praise from the observer is not required. The child will be motivated to try another task if he is allowed to check the results of a previous task. Interest in what the child is doing is vital, but exclamations such as "GREAT", "TERRIFIC", "GREAT JOB" are redundant. Success is the most effective motivator that exists. On the other hand, failure must not be admonished. This is not a pass/fail type of activity. If the observations come through the use of some type of game, the observer must remember that it is not the winning of the game that is important, it is "how the game is played."

What strategies do children use? What complexity? What relationships?

Video-tape equipment, if the children are comfortable (often no problem at all) is the ideal way to record observations.
If this is not a feasible tool to use, written notes can be kept as the observations are made. It is very important to explain to the child what you are doing and to do it in a way that does not distract the child. (A tape-recorder is also an excellent tool. It is fun for the child when he, later, can hear himself when the tape is played.)

The observer will find many rewards in this kind of interaction with children. He or she will also find many unexpected approaches to learning. The tools are simple. The requirements for successful observing are simple:

1. Discover how a child perceives his world.
2. Determine developmental levels of children.
3. Learn to be patient - thinking takes time.
4. Be aware of the fallibility of spoken language.
5. Learn to never assume - an adult can no longer relate to the world as a child does.
6. Persevere as long as there are unanswered questions about how children learn.

When is a Problem a Problem?

There has been concern of late about children's ability in problem solving. As a kindergarten teacher I have difficulty comprehending this.

Children begin their formal education with great competency in problem solving. The methods they devise are as varied as are their physical characteristics, but they are, nevertheless, capable of recognizing the problem, considering the alternatives, and arriving at a solution (or solutions) while utilizing a complex preoperational system of logic.

Several factors, however, must be present to enable a child to solve problems:

1. The problem must be expressed using language a child is developmentally able to comprehend;
2. The problem must be able to be interpreted as one to which a child can apply what he has learned in past experiences;
3. The problem must have some personal significance. At the preoperational level it must also have immediate significance;
4. The child must have access to tools that are developmentally appropriate to his level and with which he can work comfortably;
5. The child must feel secure in the knowledge that the "right" answer is not the prime concern. He knows that his own thinking will be given credence;
6. The child needs to know that he will be given the opportunity to verify the results of his efforts.

The following is a very simple illustration of problem-solving (challenge acceptance) in a kindergarten class.

The day began with the usual unfolding of what had happened the night before or on the way to school. After everyone arrived it was quite obvious that there were several children missing. In fact, there were only thirteen children in class. Some of the children expressed concern about the number of children that would sit at each of four round tables. No one wanted to sit by himself. The accepted arrangement was four children at each table.

How could they arrange themselves in order not to have any one child seated by himself? The children attempted to solve the problem by using the bead strings. We had been using the bead strings for computations for only a short time and it became clear that the children were not yet comfortable enough with this tool.

I suggested that they use one inch cubes and pegs. The blocks could represent the tables and the pegs could represent the thirteen children.

In about four minutes they announced enthusiastically that there were two solutions:

Solution 1. 2 tables with 4 children each,
1 table with 3 children,
1 table with 2 children.

***

Solution 2. 1 table with 4 children,
3 tables with 3 children each.

After the children completed the task they verified the results of their "computations" by physically applying one solution and then the second. (One child physically arranged the other children at the tables).

They had the tools developmentally appropriate to their level of understanding. They were motivated to accept the challenge, find the solutions, and verify the results. What more could a teacher desire!

Teachers, Too, Learn By Doing

A priori knowledge that preoperational children perceive a total sentence before they have the visual acuity to distinguish one element in the sentence (a word) did not deter me from giving each of the children a mimeographed page as follows:

My name is________________________________.
The number of my house is_________________.
The street I live on is called____________.
The number on my telephone is_____________.
I was born on_____________________________.
I am_________________years old.

This was to be a reading exercise, using context to decode words with which they were unfamiliar. It was also an attempt to facilitate each child's learning of his address and telephone number.

Teacher learned a lot that day. The children seemed to be extremely confused.

The only two sentences to which they could relate were the first and the last. (I had previously filled in all the needed information, except for the first and last line.) The children were to read the sentences and to fill in the blank on the last line.

These are the problems which arose:

1. Many of the children could not say their first and last name without inserting their middle name.
2. There was no visible number on their house; therefore, their house had no number.

3. The numbers were too many to be able to be read; they could say one and two digit numbers, but not three or four digit numbers.
4. The street name was discernable by most of the children, but no one could separate the house number from the street name when asked to say their address.
5. A telephone number was something to be recited in totality; it was not something that could be read digit by digit. (Some of the children were familiar with the location of numbers on the phone when dialing a specific number, but the number dialed was not their own; therefore, they were not cognizant of the fact that their own number could be read as individual digits.)
6. When reading the sentence about the birth date, the same problem arose - a date of birth is to be recited, not read.
7. The last line caused some consternation for a few children because they could not perceive that something could be inserted on a line in the middle of a sentence. (My reaction to several responses was that in the child's thinking the blank was as meaningful a part of the sentence as any other part; that is, the sentence was viewed as a whole that could not be altered.

Rather then facilitating learning, I am afraid that I caused a great deal of confusion. Perhaps, this did create disequilibrium and helped a few of the children to perceive written language in a different way. I hope so.

Freedom To Speak

Children must verbalize their ideas, express their thoughts, and interact with their peers. Freedom to use spoken language will enable a child to progress from egocentric thinking to social interaction. His views then become less personal and will become more universal.

The function of language evolves in a hierarchical order. In the first stage of development a child's speech is egocentric which consists of three categories: (1) repetition (echolalia), (2) monologue, and (3) dual or collective monologue.

A child who employs collective monologue attends to no other point of view but his own. There is an association of thought or action with another child, but no interaction.

In order to verify this Piagetian concept, I asked each child in my kindergarten class to choose a partner. They were then instructed to each ask the other child about his favorite color and his favorite food. After the children had been given a fair amount of time to obtain the information, I asked each child, in turn, to share what he had discovered about his partner's favorite color and his favorite food with the class.

As I stood on the periphery of the group, I observed what appeared to be very obvious and very audible verbal exchanges between the partners. When asked to share the information, not one of the children was able to enlighten the class regarding his partner's preferences. It had been, indeed, an exercise illustrating collective monologue.

The next state in the hierarchical development of the function of language can be illustrated by a frequent event that occurred in my kindergarten class one particular year. There were two little girls whose names I was constantly confusing. Traci was not concerned when I would call her Krystal. Krystal, however, when addressed incorrectly reminded me most vehemently that her name was not Traci. In a final attempt to help the teacher use her correct name, she stated that the use of her middle name would solve the problem.

Krystal had adopted the point of view of the teacher, a specific hearer, and had proposed a solution to the hearer's action - or incorrect action. This stage is called that of adapted information.

Following the stage of adapted information is one which Piaget characterized by criticism: remarks are made about specific statements or affective remarks made by others. As one child acts upon what is said by others, arguments and quarrels occur. It is through this interaction that rules of logic and forms of deductive reasoning have their beginnings.

The last three stages in the development of the function of language are those of (1) commands, requests, and threats, (2) questions, and (3) answers.

Between the ages of three to eleven years a child's thinking about reality evolves from (1) realism to objectivity, (2) from realism to reciprocity, and (3) from realism to relativity. As a child progresses through these stages he is developing and refining semiotic (symbolic) functions and he is establishing the foundation of his future social and moral behavior.

The first belief in the first stage of the evolution of reality has been called animism. It is at this earliest stage that a child attributes human characteristics to natural phenomena in order to justify a particular occurrence or incidence.

The second belief of the first stage is the one in which a child explicates causality, events, and concepts by referring to God, Heaven, and/or a higher authority who is omniscient, such as "Dad", "my uncle who is old", and "my Mother".

The spontaneous discussion which follows reflects the second belief of the first stage in the child's evolution of reality. It also elucidates the level of semiotic development of the four children who were the participants.

IS THERE A DEVIL?

Jennifer (5;10): (Very emphatically) I know there ain't a devil. My Mom told me!

Heather (5;9): (Very sagaciously) If there is, he drags you by your heels!

Jamie K. (5;9): Just fire down there.

Jennifer (5;10): Only a fairy tale to make little kids scared.

Teacher: The devil is only a fairy tale to scare little children?

Jennifer (5;10): A little fairy tale.

Jamie K. (5;9): Only make little kids scared.

Jennifer (5;10): I stayed up all night watching TV because I was too afraid of the devil. Uncle Joey told me.

Jennifer goes on to relate the plot of the TV movie she saw. She then clarifies for the sake of the teacher that her Uncle Joey had told her that the devil was going to "get her". She had stayed awake to see if the devil was real.

Jennifer (5;10): My Mom done told me. (She is again explaining that the devil is not real and verifies that fact by quoting an impeachable authority.)
It's true, too.

Jamie K. (5;9): 'Cause way the whole truth is!

Heather (5;9): My cousin told me there was a devil down there. (Not to be dissuaded by what was said by Jennifer and Jamie K.)

Jamie K. (5;9): My grandma's friend died. She really cared about him. I think he's mean. They buried him in a couple days, in the church's way.

Jennifer (5;10): In some states there is a devil; in some states, not a devil. (She pauses a moment and then goes on to explain.)
Devil hides in Mexico and he leaves us alone here.

Heather (5;9): (Points down to the floor) Down here, there is a devil.

Jamie K. (5;9): (Very determinedly) I'm going to say something....
In New Mexico, there is! (a devil)

There is a comment or two injected by Jennifer and Heather. Each is quite determined to stick to her previous statement.

Jamie K. (5;9): (She continues to explain.) In the Bible...tell the truth...not preacher... God!
(God) makes us live to grow up to be a grandmother.

Jamie V. has been on the edge of the conversation. She is pondering the comments rather pensively, then she very stoically makes the following claim:

Jamie V. (6;5): There's no God!

Heather (5;9): My Mommy says and my big cousin says there is ... (a devil) He does (read the Bible). He's big!

Jennifer has a determined look on her face as she once again explains that the devil does not live in this state; therefore, she postulates, one need not be concerned about his presence.

Jamie V. (6;5): (Very inobtrusively) No God.

Jennifer (5;10): Do you have a legend book?
Bring the encyclopedia.

Jennifer directs Jamie K. to get one of the volumes from the set of encyclopedias to which the children often refer when they are searching for answers to questions.

Jamie K. quickly complies with Jennifer's request, and she returns to the table with one of the volumes, opens it, and begins to verify her early assertions.

Jamie K. (5;9): (She uses her index finger to follow the "verses" she is reading.) Tells about God and "spirit".

Jamie V. (6;5): There is no devil or God...
"Cause when we're dead, we're dead. If there was one then we'll come back.

Teacher: Come back from where, Jamie?

Jamie V. (6;5): ....from devil or God. (She goes on to elucidate.) We only be made one time. God and devil is dead. They don't make us no more!

The preoperational children who participated in this conversation each approached the question, "Is there a devil?" in a manner that was indicative of their developmental level. The conversation ended very abruptly when the idea that there was no God could not be handled by some of the children.

As the teacher, or rather the observer, I felt that the children needed no comment from another adult "authority" to confuse the issue any further. One issue had been resolved to the satisfaction of most of the members of the group. The new information was not in the realm of understanding of the children.

Preoperational children are in the process of constructing the foundation on which all future learning will be built. If language and thinking of a child are to have a firm foundation, a child must have freedom to speak, to express his ideas, to evaluate new ideas, to question, to verify, to defend, and to share what he has learned in a developmentally appropriate way.

When a child has freedom to express his ideas in a secure environment, his thinking will continue to evolve from the egocentric, personal level to the level of social, relational, and universal thought.

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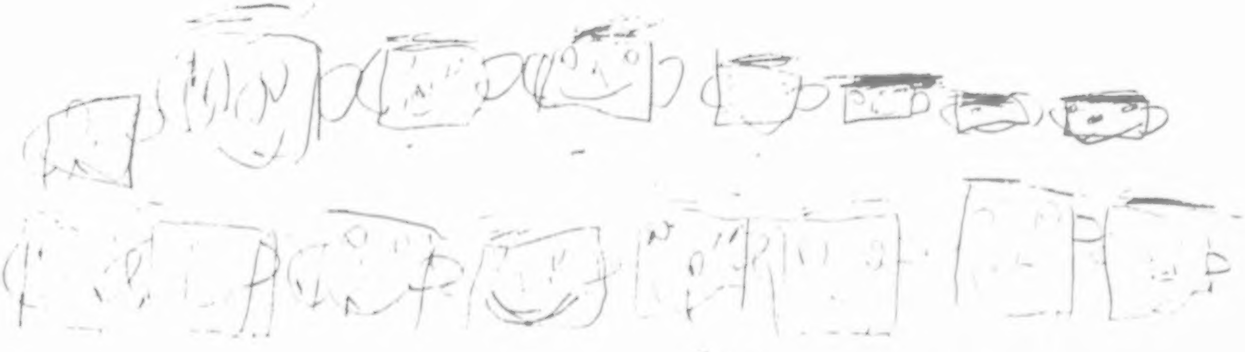
Heather



Teachers As Researchers!

Teachers, for the most part, are all too willing to be the receptacles into which researchers pour the contents of their overflowing pots of statistics, speculations, and theories. And researchers, often, are all too willing to have teachers be passive receptacles. The same goes for textbooks. Teachers are often happy to accept without questions some prepackaged curriculum and certainly publishers encourage, even pander to, this passivity.

Why can't teachers be researchers and curriculum developers? There is so much to be learned about how children learn, how children perceive their world, and how children think. Such knowledge is fundamental to education of every level. Why, when the opportunity is available every school day in every classroom, do we not use our knowledge, skill, and expertise to learn how children learn? Will we not have the research that is far more utilitarian, accurate, and viable? Who has more concern or desire to learn what is useful in the classroom? Who has the greatest amount of experience meeting the needs of children and helping them relate to their environment? Who has a greater stake in obtaining precise, valid information.

To whom falls the opportunity and responsibility of developing and using educational theories? Who has had the greater amount of experience working with children in a normal environment - researcher or teacher?

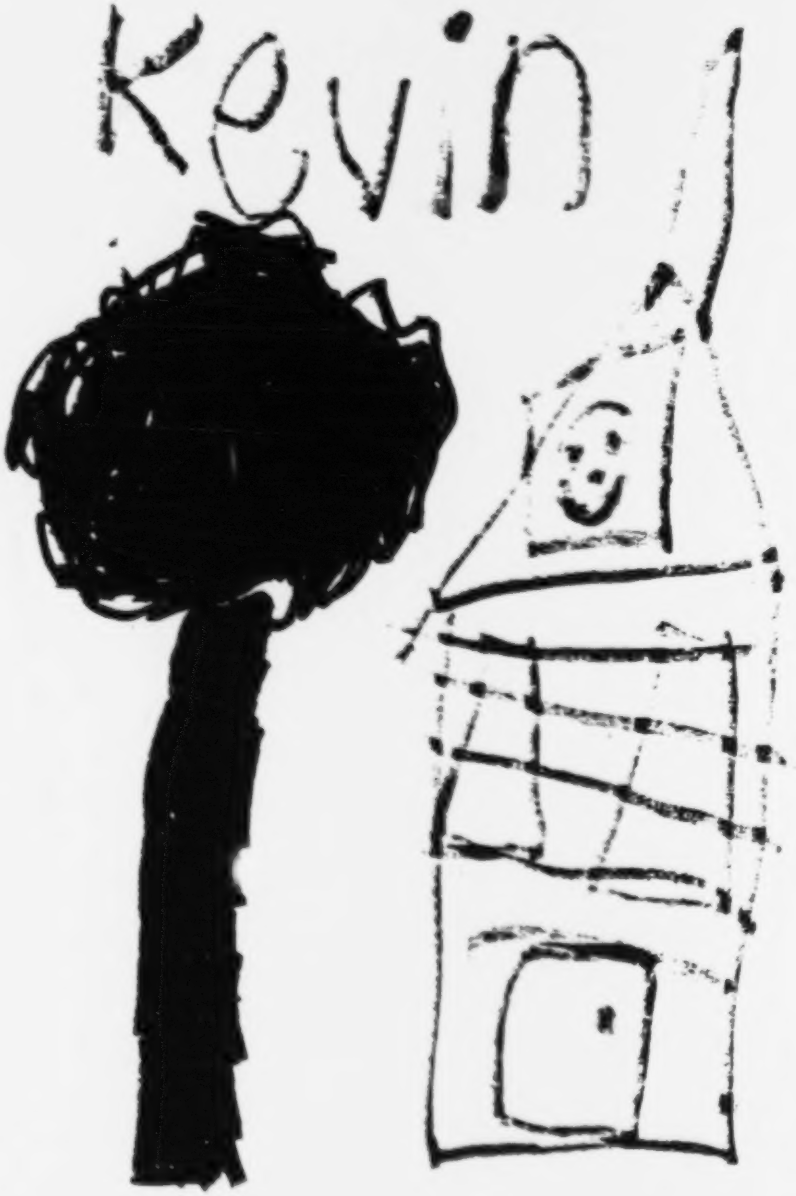
What I am suggesting is not more paperwork for teachers. Heaven knows, there is enough of that already! I am advocating that teachers be given more credibility for knowing something about their chosen profession. I am advocating that those who publish the textbooks give experienced teachers the opportunity to use their ideas on how children can achieve in the way that is meaningful to them. I am advocating that experienced, concerned teachers take the responsibility of sharing their observations about children in some tangible way with others in the profession.

There is so much to be done to make education worthwhile and meaningful! If every successful teacher would realize that their thoughts and ideas about learning are equally as important as those who call themselves authorities, I'm sure many problems in education would be solved. If every successful teacher, and every teacher who has had some success in some area of teaching would share one idea, think how much could be learned. There are more than five hundred teachers in my district alone. If each teacher shared one idea about how children learn, imagine the questions that could be answered!

Teachers are in the right place! Teachers have the expertise to be researchers! Teachers have the most to gain as we learn more about how children think and reason. Teachers need only, not merely look at what children are doing, but observe carefully the manner in which they solve problems. Teachers must listen to what children are saying and question, question, question to discover what a child is thinking. Teachers must then take the responsibility to share the research they have done. Administrators and textbook publishers must realize that teachers are the "authorities" to whom they can richly turn for valid research.

Published research can be helpful as a supplement to practical research which originates in the classroom. But published research is not the "great God" to which teachers must pay homage.

Teachers hold the keys that will open the door to learning. Teachers must learn to observe children and discover how children perceive their world. The responsibility each teacher has to be a researcher is a big one. The opportunity is big. The payoff is big. Teachers need to be unshackled to grow, to learn, to share.



Partnership for Progress

How do children learn? Who has the clue? Educators are often so involved with subject matter that concern for children becomes purely secondary. A doctoral student said to me recently that learning by experience is very inefficient! "There are too many facts to be learned."

But what facts will children need to know in the year 2025 when today's children reach adulthood? It is widely predicted that many of the occupations for which people are trained in 1982 will be obsolete by the year 2000.

Who then do the constructivists turn to for help in changing a backwards looking system of education? Why not turn to those who understand that children learn best by experiencing the world around them - the parents! Piaget began his work by observing his children and how they perceived the world around them. Parents seem to understand and concur without hesitation that learning is a developmental process - that children learn best by doing things themselves as opposed to being told. Parents are aware that a child will learn best something that is meaningful to him, something that is important to him.

Dr. T. O'Brien has observed that those who were colleagues of Piaget would in informal conversations discuss their observations of their own children. Perhaps the vast amount of knowledge they have given us about children is the extension of the knowledge they acquired first as parents and later as epistemologists!

Why do parents perceive what some educators cannot? Is it because the parents consider the whole child and educators deal with the child only in the realm of the classroom situation? Parents have often said that their child is much different at home than he is in school. Does this indicate that his learning style is also completely different? Or does this lend credibility to the fact that children adapt quickly to whatever environment in which they may find themselves? Does the ability to adapt mean that a child will change his natural learning style? Learning styles are not changed easily.

Would it not be far better to facilitate a child's learning in a heuristic manner rather then by directive teaching? Education is not an esoteric subject, the privity of a select group of individuals who consider themselves experts because they have earned a college degree. A child's education begins the moment he is born. Parents, relatives, members of the community, and the media all contribute to a child's education long before that child begins his years of formal education.

John Holt, author of How Children Learn and How Children Fail, is currently strongly advocating that parents teach their children at home and not subject them to the dehumanizing, coke-machine teaching methods of a public school.

Is education in the public schools irremediable? Can only those of us who are parents teach? The answer to both queries, of course, is no. It is, however, imperative that we reconsider the priorities of education in public schools. Logic demands that everyone concerned with a child's learning have an integral part in the progress. The Chinese long ago learned that a child's education was something to be nurtured and facilitated and reenforced by teacher, parents, grandparents, society. It is everyone's responsibility to give continuity to that child's learning if it is to be meaningful to the child. If the Chinese can accomplish this, I'm sure we Americans can achieve as much.

We must not continue to regard the classroom as a sanctum sanctorum, an inviolate place over whose threshold no parent dare trespass. Medieval teaching methods must be superseded by those which consider child first and the dispensing of facts second. We must recognize that children need no longer be the sole respository of facts. We now have computers that are far more capable of doing that.

When learning becomes a shared responsibility and a cooperative effort among educators, parents, and community, the burden of educating children will be lessened. Educators must assume the role of the learner and look to parents to facilitate that learning. Educators must learn to talk less and listen more. The Parent - Teacher relationship must be built on mutual respect and common concern.

This must be done; this can be done; this will be done, if public school education is to survive and progress.

The time has come to listen to what children have been trying to tell teachers for a very long time - "We want to learn. We are trying our best to understand. We will learn in our own way what we are capable of understanding. We will learn those things that relate to our environment, our world!"

Counting As A Tool

Two little boys were very excited by their discovery; they found that one boy had ten fingers and two boys had twenty fingers. They made this discovery by counting.

Teacher: How many fingers will three boys have?

Two more children were recruited to solve the problem. One of them stood with the first two; the other was needed to do the counting.

James: (beginning with the first boy) 1,2,3,4,5,6,7,8,9,10,...30.

Teacher: How many fingers will four boys have?

Another child is added to the group.

James: (beginning with the first boy) 1,2,3,4,5,6,7,8,9,10,...40.

Teacher: How many fingers will five boys have?

James: "41". (This is his estimation. He then begins the count again at one.) 1,2,3,4,5,6,7,8,9,10,11,...51.

Teacher: Check it again.

Billy: That means do it again. (He felt that James needed an interpretation of the word "check".)

James: 1,2,3,4,5,6,7,8,9,10,11,...50.

Tommy: If you have one more, that's 17.

Teacher: How many fingers will six boys have?

Tommy: "17".

Joe: "60".

Teacher: How many fingers did five boys have?

James: (begins to count from one again) 1,2,3,4,5,6,7,8,9,10,11,... 50.

(There is a short pause.)

Six boys have sixty fingers.

(He counts from one again, after a sixth child has been added to the group.) 1,2,3,4,5,6,7,8,9,10,11,...60.

"60" sounds like "6".

The teacher wrote the results of the counting on the chalkboard. The children read as she recorded the results of their effort.

1 boy has 10 fingers.

2 boys have 20 fingers.

3 boys have 30 fingers.

4 boys have 40 fingers.

5 boys have 50 fingers.

6 boys have 60 fingers.

(From this point the children no longer did any counting. They contributed the numbers based on the pattern they had perceived when carrying out the physical task.)

7 boys have 70 fingers.

8 boys have 80 fingers.

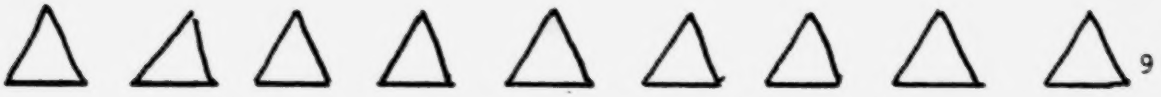
9 boys have 90 fingers.

10 boys have "10'ty" fingers.

(This fit the pattern. It was explained to the children as being the correct thinking, but needed to be written as 100.)

10 boys have 100 fingers.

Nine triangles were drawn on the chalkboard. The total number of triangles was written at the end of the row of triangles.



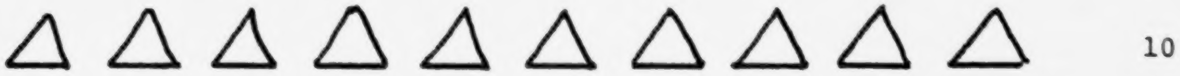
Question: How can nine triangles be changed to ten?

Mike counted all the triangles.

Mike erased the number symbol "9".

He drew one more triangle.

He wrote "10" at the end of the line.



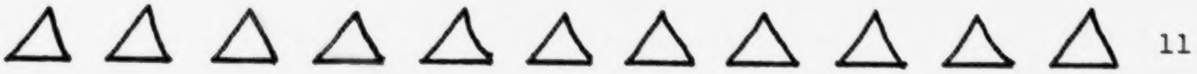
Question: How can ten triangles by changed to eleven?

Mike counted all the triangles, again.

Mike erased the number symbol "10".

He drew one more triangle.

He wrote "11" at the end of the line.



Question: How can eleven triangles be changed to twelve?

Mike re-counted the triangles.

Mike added one more triangle.

He did NOT change the number symbol "11" to "12".

Mike preceded to go back to the first triangle drawn. He drew twelve new triangles in one-to-one correspondance to the original row. He counted all the new triangles. At the end of his new row of twelve triangles he wrote the number symbol "12".

****

Mary: How do you write a "12"?
That's how many people are here.
You don't have to count now!
Patty: Twelve is a twelve!
Figure it out by yourself!
If you know how to count to twelve, then you can count to twelve (write "12")
Class: (in unison) 1,2,3,4,5,6,7,8,9,10,11,12.
(as each child was re-counted)
Patty: You have to know how to count numbers to remember numbers.

"You have to know how to count numbers to remember numbers." Patty's observation requires thoughtful consideration. Investigations In Mathematics Education, (Geoffrey Saxe), reports that knowledge children obtained by counting could facilitate many mathematical tasks in the primary grades. Children are very interested in counting, whether they are "working" or playing. Counting can enable a child to develop number conservation. Knowledge of counting strategies can help a child construct a system that he may use for basic addition and subtraction facts.

As Mike counted the triangles each time, he developed the meaning of class-inclusion. It was a process that was repeated several times in assimilating and accommodating the concept. As he counted he became aware of the one-more relationship. He found that ten was one more than nine, eleven was one more than ten, and that twelve was one more than eleven. He mentally placed them in a class-inclusion set. (Labinowicz, 1980)

Counting is one of children's earliest attempts to understand mathematics. A child has a spontaneous interest in counting. Very young children "count" before they can verbalize the numerical terms correctly. Counting involves interaction between a child and the physical elements in his environment. He must physically act upon items as he counts them. (If a child does not physically relate to the items he counts, he can be helped to achieve counting proficiency. The child needs to touch each item individually and to push each item counted away from the yet-to-be-counted items.)

Counting facilitates a child's logical mathematical knowledge. Counting is self-directed learning which a child will do initially using concrete objects. As he matures he is able to apply systems of counting to mental constructs. He no longer will need the concrete items to solve mathematical problems.

The children who are doing finger counting have become very proficient counters. They had internalized the pattern of counting words needed to count from one to one hundred. They understood the one-to-one relationship between each consecutive number name and each finger in the total set. The physical act of counting each finger was a method that enabled the children to advance from perceptual item counting to mental constructs of how many fingers seven boys would have, how many fingers eight boys would have, how many fingers nine boys would have, and how many fingers ten boys would have.

Herb Ginsburg in, Children's Arithmetic: the learning process says that counting is a child's chief mathematical tool. Counting is the basis of many arithmetic problems and should be encouraged. A child who has internalized the concept of one-to-one correspondence and who has achieved number name proficiency develops a great deal of self-confidence and is eager to expand his thinking about numbers. He will be able to find the patterns in numbers and the consistencies that will facilitate later learning.

Researchers have verified the richness of using counting to develop methematical concepts. Teachers have a theoretically sound basis for facilitiating learning by encouraging children to count. Children are "intuitively" interested in counting.

Note:

"Counting" should not be construed as the spewing forth of number names. "Counting" referred to in this article is a compelx act which requires an understanding of one-to-one correspondence and the use of correct number names in the sequential order.

Remember what one small child said: "You have to know how to count numbers to remember numbers".

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Personal observations of kindergarten children, 1981-1982 school year, Logan School.

A Ball Of Clay

Teacher: "Does everyone have some clay?"

Children: Everyone nods to confirm the fact that they have clay.

Teacher: "Let's squeeze it, and squeeze it, first with one hand and then the other."

Children: Everyone begins the task of making the clay more pliable. A few grunts and groans are emoted, but generally children diligently continue the task.

Teacher: "How does your clay feel, John?"

John: "It's hard!"

Teacher: "Hold it with both hands and squeeze a few more times."

Teacher: "Jamie, what does your clay feel like now?"

Jamie: There is no verbal response, but he begins pounding it against the table. Then he replies, "It's fine."

Teacher: "Jamie, use your hands."

Jamie: He takes the clay and once again uses both hands to squeeze the hunk of clay.

Teacher: "What shape can we make with the clay?"

Children: "Round." "A circle." "A ball."

Teacher: "Put the clay in the middle of one hand; put the other hand on the top and roll the clay around." (As she is explaining the technique, she is physically demonstrating the process.)

The teacher continues to roll the clay around in her hands as she observes each child. Some are quickly able to imitate the action. As simplistic as it may sound, there are a few children who have a great difficulty in coordinating the actions of both hands simultaneously.

Teacher: "Let's close our eyes while we are rolling the clay in our hands."

Children: "Circles."

Teacher: "How many circles can you see?"

Children: "One." "Two." "Lots." "A million trillon."

Teacher: "What do they look like?"

Children: "Mine are red." "Silver." "I just see black."

Teacher: "What are your circles doing?"

Children: "Going around." "Up and down." "Like wheels."

Teacher: "Let's make our hands go around slower and slower. Now what do you see?"

Children: "They're slow." "They're silver."

Teacher: "Open your eyes. Look at the clay in your hand. Tell yourself exactly what it looks like. Tell your friend exactly what it looks like."

Children: Everyone looks at the smooth round ball they have in their hands. There is a bit of banter among the children for a few minutes.

Teacher: She walks to each child and takes his precious ball of clay and places the balls in a random order on the chalk rack. "We have all looked at our balls very carefully. Everyone come up now and find your own ball."

Children: There are very perplexed looks on the faces of some of the children, but very resolutely they come up to retrieve their special creation. Each artisan carefully scrutinizes one ball and the next. Several times one hears. "That's my ball." The conflicts are quickly settled.

Finally all the balls have been retrieved by their owners, except for one, and teacher does not have hers. The last remaining sphere is rather small and erratically shaped, but every one of the children is positive that he has his own.

Teacher: "Can you make the ball bigger?"
"Can you make the ball smaller?"
"Can you make it thinner?"
"Can you make it thicker?"

Making a lump of clay into a ball is a very simplistic task for most young children. This task can become a learning experience and can be of tremendous value as a diagnostic tool for the teacher.

The physical manipulations required gross motor activities and fine motor skills when the children were required to squeeze the clay with both hands and then with one hand. There was also an excercise in coordination as the children rotated the clay in the palms of both hands to form a sphere.

Mental imagery evolved as the children closed their eyes and were asked to describe what they saw as they moved the ball with their hands. In an age when society is so visually oriented, the need for imagery to augment learning and to enhance the mental ability to retain information is tremendous.

Visual acuity was enhanced as the children examined the balls and noted miniscule details in order to retrieve their own creations from the many others. At the preoperational level, this is an important prerequisite for recognizing individual shapes of numbers and identifying letters. As the children progress to the concrete level their global perception becomes a deterent to reading. They must be able to perceive the individual components of words.

The simple activity of making a ball of clay can become a diagnostic tool for a teacher. A cursory glance will indicate a child's motor skills as he squeezes and rolls the clay in his hands. Informal questioning of children will show their ability to conserve and their understanding of terms such as, "bigger", "smaller", "thicker", "thinner", etc.

This is an activity in which children of all developmental levels can participate simultaneously. Everyone can participate; everyone will achieve without fear of failure; everyone thinks the task is fun.

New concepts can be built on a foundation that is firm and appropriate to individual understanding. This is not a competitive task with only one right answer. The only problem may be one's own muscular coordination which can be remediated by the physical manipulation of the clay.

Thinking is expanded as the children are challenged by the teacher in a manner appropriate to each child's level. There is no "wrong." There is not only one right answer.

This activity has enabled the teacher to identify individual levels of development. It has enabled children to achieve individual success. It has been an excerise for developing gross and fine motor skills. It has facilitated visual acquity and provided the opportunity for mental imagery. It has been fun!

Language Development of Preoperational Children

Language development is a facilitator of cognitive development and, therefore, will be a part of all areas of development. Language is needed to expedite cognition. "Language mediates between external events and the child's response." (Ginsburg and Opper, 1969, p. 171) Both a child's linguistic competence and his cognitive capabilities play a part in language acquisition.

During the last fifteen to twenty years, our views regarding language acquisition have changed a great deal. Language acquisition is now understood to come from the "inside, out". The learner has become the focal point in the learning process. Within a personal, rule-governed system, the child constructs his own product. (Ferreiro, 1978) The child is the active subject who categorizes, establishes relations, constructs hypotheses, and looks for regularities in the learning process.

Piaget theorizes that the human organism does not inherit language as such; but, rather, it inherits a tendency to organize inputs and to adapt to its environment. Language is a manifestation of symbolic functioning which develops through a complex interaction between biological and experiential factors (Apolloni, 1976).

Intelligence appears before language. Verbal behavior, as it emerges, increases the powers of thought in range and speed (Wadsworth, 1972).

Physical properties of development are dominant from birth until the infant is a month or two old, then the mind controls attention (Flavell, 1977). Articulative language begins after a phase of spontaneous vocalization (six to ten or eleven months) and a phase of differentiation of phonemes by imitation (eleven to twelve months) (Flavell, 1977).

The first sounds spoken are often "pa" and "ba". The very young infant exhibits categorical perception of consonantal sounds.

Research done by Eimos (1975) shows evidence that categorical perception of speech may be dependent upon linguistic detectors in the brain. Without these detectors it would be impossible for the child to acquire speech (Flavell, 1977).

Toward the end of the sensorimotor state, the infant begins to apply a sensorimotor schema in language, as well as in symbolic play. He begins saying one word sentences to express desires, emotions, and observations. Verbal schema become the instrument of assimilation and generalization based on sensorimotor schemes.

Toward the end of the development of the sensorimotor stage, progress in conceptual representation will go hand-in-hand with that of language. The child now uses two words. Sentences appear; then short complete sentences without conjugation or declension are used.

Next there is a gradual acquisition of grammatical structures.

Language, now used for the reconstruction of past action, is in the beginning phase of representation. At this point the verbal schema is detached from the sensorimotor schema and acquires the function of new presentation. This is the state when a child achieves neither true generality nor true individuality -- he is fluctuating between two extremes (Piaget, 1962).

Language in the pre-operational state (two to seven years) is divided into two basic types -- egocentric and socialized.

The most basic form of egocentric speech is echolalia because a child babbles for his own edification and delight without being aware that he is making sounds.

When children begin to repeat what others say, they have reached the stage called delayed echolalia. This is the period in which verbal repetition can occur hours, days, or, even, weeks later (Singer, 1978).

Within the area of egocentric speech, children often go into lengthy monologues, or creative monologues.

In kindergarten this stage can be both a help and a problem. Most children delight in being the center of attention and will verbalize on a particular subject at great length. On the other hand, activities such as "Show and Tell" may be of less value than we think because the children often pay no attention to the child who was telling about the item he had brought from home.

The collective monologue is the most socialized of egocentric speech. Children will play alongside one another and be completely oblivious to the children around them.

Socialized speech is divided into four categories by Piaget: adapted information; criticism; commands, requests, and threats; and questions and answers. The first, adapted information, is the basis of socialized speech, as the function of language moves from giving self-pleasure to the function of exchanging ideas or opinions.

Criticism, the second category of socialized speech, is intentional and is directed toward a specific person. In my morning kindergarten class, Kimberly took it upon herself to tell me that Ann did not have the right page, or that Ann had spilled her milk. Kimberly was constantly criticizing and it was always directed at Ann, her "best friend".

To influence the actions of others, in order to achieve a desired goal, a child will employ commands, requests, and threats -- "I'm going to tell my mother." This is often accompanied by action or intent of action.

The last category, questions and answers, is seen in the language pattern of a two year old. Now that a child has a more extensive use of language, he is seeking the answers to everything!

In the second half of the preoperational stage (five or six years) questions are concerned with causality, origins, and the physical world. Answers that children give at this stage supplied Piaget with valuable clues to their developmental level of logic and reasoning (Singer, 1978).

The preoperational stage (two to seven) is a transitional stage from that of the sensory mode to the conceptual mode.

Reading at the Preoperational Level

Having discussed the general characteristics of language in the sensory stage and the preoperational stage, I would like to consider how a child learns to read.

Several of these characteristics make it very difficult for the preoperational child to learn to read, especially when he is confronted by a very formal reading program. The child at this stage is bound by egocentrism, inability to follow transformations, centration, and irreversibility of thinking. The actions and thoughts of preoperational children are internalized, but their thoughts are not yet liberated from perceptions. The work in a kindergarten math book regarding classification, for example, is only meaningful if the child has had the actual experience of sorting buttons, blocks, rocks, etc., and using attributes he can perceive.

In regard to egocentrism, a child thinks that everyone thinks about things in the same manner as he does. He is the hub of the universe. Other people's words or thoughts do not exist for him.

The preoperational child can anticipate cause-effect relationships, but he is unable to think about the steps in-between. When we teach letter-sound associations and expect the child to put the sounds together to make a word and to put those words into meaningful sentences, we are ignoring the fact that he is not able to follow transformations. Any child can memorize sound-symbol correspondence, but expecting the child to recognize those same graphemic-phonemic relationships when the letters are put together to make a word is not realistic. Most children who are "taught by atomistic approaches (memorizing the sound-symbol relationship only) have difficulty in comprehension" (DeMao, 1976, p. 144).

Centering refers to the ability to center attention on only one part of the whole at one time. Considering this characteristic of the preoperational child, one can readily understand that a child cannot learn the rules of phonics and word structure, and also apply them. He reasons transductively, by proximity. The sentence is always perceived earlier than the words. The child sees the whole page of a book before he sees a particular sentence. In a like manner, the sentence is recognized before individual words are seen. The very last thing a child is able to perceive are the letters within a word. Piaget refers to this concept as verbal syncretism (Piaget, 1974).

...."a preoperational child who cannot reverse his thought processes should not be expected to succeed in converting graphemes to phonemes by memorizing the sound that goes with the symbol (in reading), and, also, validating his 'knowing' by attaching the right grapheme (in writing). That takes reversibility in thinking." (DeMao, 1976, p. 146).

The characteristics of the preoperational child give educators and parents some guidelines to reading instruction. One may conclude that prerequisites for a successful beginning reading program include the ability to reverse thought and the ability to decenter perception. Millie Almy (Frost, 1967) found a high correlation between the ability to conserve concrete substances and beginning reading achievement. (DeMao, 1976, p. 146).

Piaget feels that the turning point at which children begin to understand each other and communicate is probably somewhere between the ages of seven and eight years of age (Piaget, 1974).

Writing at the Preoperational Level

As our views regarding how a child learns to read have changed in the last fifteen to twenty years, so have our views changed in regard to how a child learns to write.

Here again we adults, have erroneously imposed our way of thinking upon children.

A child has already acquired the capacity to distinguish letters from other graphic elements by the time he starts to school.

No system of writing retains all aspects of oral communication. Every system has a choice between many aspects of speech. Our alphabetic system ignores certain important aspects of speech, such as intonation. It also introduces certain conventions that are not in speech, such as the separation between words.

Anything that we know about the way a child learns to speak will be relevant. "Understanding writing demands a certain amount of reflection and conceptualization of the spoken language" (Ferreiro, 1978, p. 27).

Piaget emphasizes the fact that children should have a large conceptual base acquired from first hand experience rather than just force-fed memory. Only in this way will words have meaning for them. In a like manner, a child has to engage in an active construction process in order to accommodate information and master skills.

In the earliest stages children believe that only nouns - names of items, can be written. As they mature, it is difficult for them to distinguish individual sentences in a written text.

At the next level children believe that nouns are written independently, but verbs are not.

The children progress then to the level in which they believe everything is written, except the articles such as "as", "the", "a", "an". Until the age of seven, some children do not consider articles to be words which can be written.

The most mature children believe everything which is spoken can be written down. It is at this last stage that a child fully understands the presupposition basic to our writing system that every uttered word can be written down.

All of the children found the separation between words to be most disturbing. A child's concept of writing does not correspond to that of an adult's.

A child starts very early to understand the writing system and proceeds in ways ignored by pedagogical practices. This child's activity is very complex. All his cognitive and linguistic capacities are at work to accomplish this understanding (Ferreiro, 1978, p. 39).

"In order to understand the writing system which society has forged for its children, children must reinvent writing and, thereby, make it their own." (Ferreiro, 1978, p. 39).

The written text is often not considered as a graphic representation which mirrors speech.

A child often expects to see only the elements of reality referred to in the utterance represented in the text.

A child often cannot accommodate the idea of the segmentation that would fit the written text.

On one hand, the child cannot conceive that the utterance as a whole to be represented, is a sentence; and the child is unable to see that a single sentence can be part of the written text. On the other hand, the child thinks there must be similar things in other sentences; that is, sentences semantically close to the first.

A child has taken a big step forward when he assumes that a verb can be represented in writing.

The problem of the article is the final one to be resolved. Because children do not feel that anything with three or less letters can possibly be a word, they consider the articles as a piece of language necessary when composing an utterance, but impossible to read. Rules and restrictions of oral language are not easily transposed into rules that govern the written text for the preoperational child.

Much research has yet to be done in the area of the written language for the preoperational child. At this point, it is clear that a child's efforts to understand the written language begin very early. It also seems to be very obvious that children use very complex activity involving their cognitive and linguistic capacities to reinvent writing and thereby, make it their own (Ferreiro, 1978, p. 39).

Language-Experience Approach

On the concrete-operational level of development, the language-experience approach will enable a child to develop cognition necessary for reading. The major premise on which the language-experience approach is based is as follows:

> "What I can think about, I can talk about."
>
> "What I can say, I can write."
>
> "What I can write, I can read."
>
> "I can read what I write and what other people write for me to read." (DeMao, 1976, p. 150)

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I'm Not Sure What You're Asking, Please Say It Again

"Why isn't there one of those there? Daniel asks.

"That's an out one," Traci declares.

"Those are mouses," states Shane.

"The end of the line is a window," explains Julie.

"No one is coming to school because no one was here when I came," announces Scott.

"I can't hang up the bead strings with all the blue beads at the top because some of the strings are hanging with the blue ones at the bottom," Jamie replies.

These statements are typical of preoperational children. Each one of the above statements is quite logical in terms of preoperational development. They show significant thought and indicate that the children were accommodating and assimilating several concepts.

The question asked by Daniel related to three sentences written on the chalkboard. Sentence one and sentence two were too long to be completed in one continuous line; therefore, each sentence was completed on a second line. Daniel recognized that a sentence consisted of a series of words and knew that at the end of the sentence there should be a period. He was asking why there was no period at the end of the first line of words. He was not expressing himself in "Adultian" because he could not find the language that would logically convey his thoughts, but he knew what he wanted to ask.

Traci's statement was very simplistic. She needed more glue to complete her project and her jar was empty. It was out of glue; therefore, it was an "out" one.

Shane was using the plural form of the word "mouse" in a typically preoperational fashion and, perhaps, a more logical manner than the adult language requires.

Julie's explanation of the "end of the line" was very perplexing until closer observation revealed that her position each day at the end of the line was next to the window.

Scott's reasoning and use of the word "because" was certainly representative of preoperational logic. In his egocentric world, the absence of children when he arrived was the reason no one else was going to come.

The inability of Jamie to reverse the bead strings in his thinking was perfectly sensible. His thinking is still based on what he perceives visually and he has not yet reached the level in which what is seen will remain the same if reversed. He has not assimilated the concept of conservation.

Some time ago an article appeared in Early Years Magazine in which a kindergarten teacher reported that when she asked a child in her class why the eyes were on an Easter basket, the child answered, "So it could see out", and she was able to understand what the child meant that it was time for her to retire. In reality this should be the beginning of her career for she had overcome the immense obstacle every adult faces in a child's world - communication.

Communication between teacher and student, as all educators will concur, is vital to the learning process. Communication with the preoperational child is even more important. It is at this level that the foundations for formal learning and future living are constructed.

The preoperational child's thought is hard to understand because the adult cannot turn himself into a child, the adult cannot measure the limits of a child's understanding, and the child cannot find the language that will logically convey the various shades of meaning to express himself. Adults can open the lines of communication with young children by having the patience to help the child develop his verbal skills, by becoming the model a child can emulate, and by being extremely flexible in their expectations. Too often we jump in with adult views and we are jumping into a foreign land. It is wiser to question and ponder before censuring a child's response.

In The Essential Piaget (Howard Gruber and J. Jacques Voneche, page 117), Jean Piaget expressed his hope "...that the day will come when child thought will be placed on the same level in relation to adult, normal, and civilized thought..."

The investigation of the child's thought processes will enable adults to understand a preoperational child's language to a greater extent. Conversely, if adults take time to LOOK, LISTEN, LEARN, AND QUESTION when children try to communicate, a child's language pattern may facilitate investigation of his thought processes.

Tomorrow May Be Too Late

"Out of the mouths of babes" is an aphorism frequently expressed by adults. What enables a child to evaluate his world with such good sense? Does this naive insight which children possess have educational significance?

Jesus Christ admonished his followers to become as children to achieve the kingdom of heaven. I do not presume to foist upon others my religious beliefs, but I do speculate about the immense importance given to a child's thought.

Is it purely a simplistic quality, devoid of the complicated, tangled thoughts of an adult mind? Is it the ability to perceive one pertinent facet of life and to verbalize what is observed? Is it the quality of being able to discern what is obvious and relevant?

Are these qualities, not only relevant to education, but those which should be nurtured and augmented? How many adults are lost because we cannot "see the forest for the trees"? We become so entangled in a web of facts and meaningless figures and so encumbered with rules that we are no longer capable of thinking.

Jean Piaget in the book, The Essential Piaget, by Howard E. Gruber and J. Jacques Voneche, said that an adult cannot turn himself into a child again in order to understand how a child thinks. We, as adults, can learn much from Piaget's research and address ourselves to the developmental requirements of the child as we now recognize them to be.

We no longer have to provide a tangled web of facts, figures, and rules. There are computers programmed to do this very tirelessly, very patiently, very consistently, very proficiently - and without renumeration. Teachers need not be the disseminators of information; computers will contain more information, available to any child at a touch of a key, than all educators combined now possess.

Dr. Assimmov presaged a change in society commensurate to that resulting from the Industrial Revolution - not in the year 2000, but now. This fact alone indicates that sagacious educators acknowledge the indubitable effect that computers will have on education. Will their decision be to view computers as devices to accelerate the dissemination of information and, thereby, negate the necessity for the "human" teacher? Will this marvelous tool for learning then become an odious monster that destroys human interaction?

Hopefully, the computers will become (as they were meant to be) adjunct to learning; one which will enable the teacher to facilitate learning on an individual basis; one which will abolish tedious, repetitious tasks that are so time consuming; one which will enable educators to see the "forest" in spite of the "trees".

Educators, as adults, cannot become children, but they can display their sagaciousness and astute perception regarding the imminent changes which are occuring in education. They can become as children in that they can learn from children who are most knowledgable about learning. Tomorrow it may be too late!

Girl/Friend, Roast/Meat

The kindergarten class was instructed to find all the pictures on the mimeographed worksheet of objects that had names that rhymed. The pictures were the following:

1. an alphabet block
2. a candy cane
3. a lock (few of the children related to this item)
4. a clock (or was it a watch?)
5. a sock (Heather said it was a stocking.)
6. an airplane

The instructions were to find all the things that rhymed and to circle them.

Jonathan had all the pictures on the page circled. When asked why, he replied that he had circled all the rhyming pictures - block, lock, clock, and sock rhymed, as did cane and plane.
(Lesson 1 for teacher: Be more explicit when giving directions.)

Heather did not circle the sock. She said that the picture showed a "stocking" and stocking did not rhyme with block.
(Lesson 2 for teacher: Ask the child to explain his work before marking an answer wrong.)

As the children worked with other printed materials, the same issues came up again.

On the letter line (alphabet letters which have accompanying pictures to illustrate the sound of each particular letter) is the letter "n". The representative picture for the sound of the letter "n" is a nest containing many eggs. "N" will always be associated with the word "eggs" for many of the children. That is the first thing they perceive when they look at that letter section of the letter line.

When working on the phonics skills required for first grade in our district, Sean refused to accept the idea that one picture was that of meat ("m" was the sound he was learning). "That's roast," he declared.

(Lesson 3 for teacher: A child identifies and labels items according to his own personal point of reference.)

Is it a hot dog, a weiner, a frankfurter, or a sausage?

Is it a girl or a friend?

Is it a picture of a girl or a doll?

Is it a collie, a dog, or a pet?

Is it a child, person, or a kid?

When the child is older developmentally and is able to conserve, the problem resolves itself to some extent. But in the preoperational level of development (where for some reason children have textbooks they must complete) this does pose a problem. Roast should not be circled on the page dealing with the sound of the letter "m". When the children are learning rhyming words, stocking certainly does not rhyme with block.

The following are the specific problems which have arisen when the children used mimeographed worksheets:

1. What the picture represents on the worksheet.
2. Child's initial label given to a particular item is irrefutable. Teacher's label is temporarily acknowledged, but when left to his own devices the child reverts to his

original thought.

(A roast is a roast; it will never be "meat".)

4. Directions given by the teacher must cover all possibilities. They must be clear and as simple as possible. They must be repeated as often as needed.
5. Motor skills vary a great deal in the average classroom. Some children do not have the dexterity to make the "X" required by many textbooks. In the concern with the manipulation of the pencil, the reason for doing the paper and the instructions may be forgotten.
6. Primary pencils do not have erasers. Children have a difficult time knowing how to handle a mistake, if they want to change an answer.

All of which raises the question, "Why do kids have to wade through these pages in the first place? Can't they address the same issues more richly with everyday classroom objects rather than playing the game "Guess the author's mind"?

When does a straight line become a line segment?

What is the difference between a digit and a numeral, a numeral and a number?

Example: 3. "Say, 'Trace the digits beside the word one and the word two. How many balloons are there in the boxes in that row?'

4. Continue the directions in a similar way until the numerals 4 through 10 have been written and the balloons have been drawn to show the number of objects named by the numerals."

(Verbatim instructions from a teacher's manual.)

Are children required to "Add", to "Mark enough", or to "Give each sum"?

(Note: These are directions children are given on page 74 and 75 of a first grade math workbook.)

Does a child understand that the same method of computation is required when he is instructed to find "how much is left?" and when he is instructed to "Subtract"?

(Note: These are directions found on page 134 and page 135 of a first grade math book.)

Are children in first grade able to understand the meaning of terms such as addend, equation?

Example: ...."Continue in the same way through several different combinations with sums of 10 or less. Stress that they are to look at the sum and think what number plus the addend shown equals the sum.

Is "Solve the equations" an appropriate instruction for six year olds?

(Note: These are the directions cited on page 51 of a first grade math workbook.)

Are language problems indigenous to only the preoperational level of development, or are there language inconsistencies in the upper grades of elementary school?

Is equivocal terminology found in other areas of learning?

Is this a problem which is irresoluble, or is there a way for teachers to expedite learning for all elementary children?

The English language is notorious for the many ambiguities which exist in our system of semantics. Adults who have attained a degree of language proficiency have difficulty communicating because of the equivocal nature of their native tongue.

Imagine the confusion that must exist for those who are learning the English language for the first time!

An adult whose native tongue is different from ours has learning skills which will facilitate comprehension of the inconsistencies of the English language. They are capable of accepting the concept that one word may have several meanings and that there may be a multiplicity of labels for the same person, place, or thing.

Young children who must find the patterns and consistencies of language are confronted by a far more complex task. They realize that everything is labeled. They do not have the cognitive skills to understand that one particular person, place, or thing can be identified by more than one or two terms. They do not have the wealth of past experiences upon which to build new concepts. Their reasoning is transductive. They accept things as they perceive them to be.

When children reach the next developmental level they are capable of considering more alternatives, but their thinking continues to be based on rather limited past experiences and on what is concrete and perceptable.

When one realizes that children do not reach the level of abstract thought until they are in Junior High School, it becomes even more apparent that ambiguous language devoid of meaning from past experiences can be a monstrous obstacle to learning.

Each day, as I observe children in my kindergarten class, I find that I am saying words that are devoid of any meaning for a small child, or that the meaning I assume the words to have is far different from the meaning ascribed to those words by the child.

Is this a problem indigenous to teaching young children? Apparently it is a problem at all levels of elementary education. A fourth grade teacher admonished the inconsistencies of terms in the required textbooks used by her students. A first grade teacher felt that some consistency of terms would facilitate learning at the primary level.

In The Piaget Primer, Labinowicz, cautions teachers to use developmentally appropriate terms when communicating with young children. He reminds teachers that Piaget was very concerned about the way teachers impose technical terminology upon children who will repeat those terms without having established any firm basis of understanding of the meaning of the terms. Adults should refrain from accepting what a child verbalizes as an indication of real knowledge.

Several of the children in my kindergarten class were very interested in magnets. They diligently investigated the entire room to find what was made of iron or steel. Observing the research methods they were using I felt that the basic concept of magnetic attraction was something that the children were beginning to understand. I decided to question the children. I learned that "iron" was something that Mother did to clothes. "Steel" is something that is wrong to do. They were saying the correct words, investigating the process; there was no understanding of the words "iron" and "steel". They had been searching for knowledge on their own because the words I had used to explain the principle of magnetism were meaningless to them.

Millie Almy in her book, Young Children's Thinking, refers to research done by Beilin and by Bruner. Both of these authorities commented about difficulties in determining test results because children sometimes labeled things incorrectly.

Mike, a member of the kindergarten class, was weighing and attempting to discover which of two quantities was bigger and which one was smaller. His findings were reported as follows:
Mike: "They're the same. Both are bigger!"

Frobisher and Gloyn in Infants Learn Mathematics stated that children must be provided with the opportunity to learn the precise use of number language if they are going to be able to construct a firm basis for future learning. "Big" as applied to an elephant has a far different meaning than "big" used to describe an apple.

A child's thinking is much more advanced than his verbal language skills. One of the children was extremely agitated after I had written five sentences which the children had dictated on the chalkboard. He repeatly asked, "Why isn't there one there?" I looked at the board. I tried to interpret his question. "Why isn't there one there?" he retorted. Finally I ascertained what he was referring to. All of the sentences were one line long, except the first which required two lines to complete. The question he was asking was, "Why is there no period at the end of the first line of words?" It was a very thoughtful question which had been the result of thinking far more advanced than were his verbal language skills.

The examples which have been cited represent language problems at the preoperational level of development. Language problems exist at all elementary levels. The line or line segment problem mentioned at the beginning of the article was mentioned by a fourth grade teacher. It was only one of many about which she commented.

Is a language for learning a feasible concept? Is it possible to determine the most explicit, meaningful terms that will facilitate learning for children from kindergarten through the sixth grade? Who must take the responsibility for the development of a language for learning?

All teachers must actively address this problem. Teachers have the expertise; teachers understand the problem; teachers are aware of the needs of children. Scientific research is valuable, but this requires experts in the field. It requires experts (teachers) who know what a child looks like, who know how a child responds, who have a personal concern for children - not one or two, but many on a daily basis.

It must involve all teachers from kindergarten through sixth grade in a cooperative effort. It is a problem that could be investigated on a district-wide basis, or, perhaps, within one single elementary school. A language for learning does not restrict a teacher's actions; it does not demand conformity. The fundamental reason for a language for learning is to insure consistency among the grades which will enable children to concentrate on learning and thinking, rather than on the interpretation of ambiguous language. What a child has done the preceding year will continue the next year in a developmentally appropriate fashion. Each year, learning will be built on a firm foundation using language to which a child can relate.

Teachers have a responsibility. They are trained to provide each child with an opportunity to acquire the knowledge he will need as an adult. A language for learning will expedite a teacher's task. Confusion and ambiguity must be eliminated. As educators, we must assume this responsibility. We must eliminate this barrier to thinking and learning. We need a precise, consistent language for learning, NOW!

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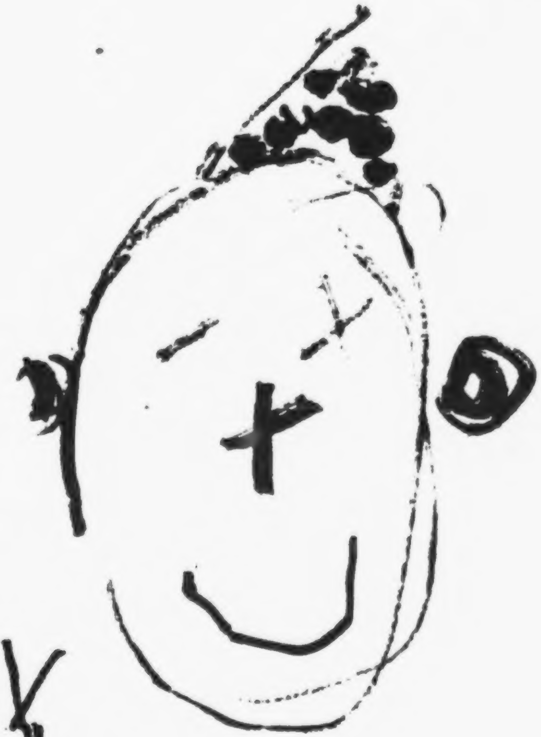

Peggy

This is a clown that
works in the circus.
His name is Clowny. Clown-Clowny.
And he works for the children.
The clown makes them laugh.
The clown is funny.

Children's Thinking About The Way Numbers Are Used

What does the number four mean? Quantity? Distance? Time? Location? Position? Signal? Code? Speed?

Is it a signifier, a designator?

Does one use it to compute, to define a place in space, to locate something, to warn another person, to make a decision. Does one simply wear it?

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Fourteen children who were members of an afternoon public school kindergarten class were asked, individually, to explain the meaning of the digit "4" which was written on the chalkboard. "4" was the only symbol written on the chalkboard. There were no other pictures with which it could be associated.

The chronological age range of these children was from five years, four months, to six years, ten months. One of the children was repeating kindergarten; one of the children whose chronological age was five years, nine months, was a proficient reader.

All of the fourteen children explained "4" in quantitative terms.

The following is a verbatim account of the responses made by the fourteen children:

Teacher: What does the "4" mean?

John: I think it's a number.

Jason: You're 4 years old.

Jonathan: "Be 14".

Teacher: Why is it "14"?

Jonathan: Probably how old you are.
"4" things that you could do working on a car.
You could do "4" things of cleaning windows and "4" snowmans.
Do "4" things of singing with piano.
And do "4" things of reading.
And do "4" things if your house catch on fire - what ever.
"4" things to clean up room.
"4" things tearing down your house.
"4" things cleaning up your house.
Get things that Mom tells you to pick up.
Do things you are supposed to be doing.
Listen to teacher.
Listen to your Mama.

Jamie: "4" things of catching rabbits.
Picking up eggs.
"4" things of piano lessons.
"4" things of looking at books.

Andy: There's "4" tables.
There's "4" chairs.

Tim: "4" Easter Rabbits come at Easter.
"4" Santa Clauses come at Christmas.
There are "4" Walt Disneys in the world.

Joe: There are "4" trash cans.
There are "4" chalkboards.

David: Somebody lays eggs.
"4" mouses in your house.

Mike: "4" candles.
The Easter Bunny hides "4" eggs.

Daniel: Chopping "4" pieces of wood.

Sariah: There's "4" people at your birthday party.

Traci: "4" glasses.

The same type of activity was done with a group of twelve children who were members of a morning public school kindergarten class.

The chronological ages of the children ranged from five years, four months, to six years, five months.

The range of cognitive development was much greater than the chronological age range.

The digit "6" was written on the chalkboard. Each child was asked to explain what he perceived to be the significance of that particular symbol.

11 children cited quantitative uses of "6".

One child gave an example of the use of "6" that indicated the symbol could be a designator.

Jamie K. (5;9): If you don't know what day it is, look by the calendar to find no. "6" day.

The following are the examples of quantitative responses given by the children:

"6" birthday spankings

"6" apples

"6" birthday cakes

"6" flags (Note: The digit was written on the chalkboard underneath the classroom flag.)

"6" oranges

"6" what number is of days (Note: This was a different type of meaning from that given by Jamie K.

"6" shoes

"6" clocks

"6" skates

That particular day Scott was wearing a shirt which had imprinted on the front and on the back the digit "6". When he asked to tell about it, he said it meant "6" ties, or "6" belts (He said that was the "decent thing!), or it referred to six pockets.

Randy, also, was wearing a shirt on which was imprinted the number "32". When asked about the number on his shirt, Randy replied that "32" was simply (only) a number on a shirt. Randy was one of the eleven children who cited a quantitative example when asked about the number "6" previously mentioned.

Conclusion:

As I evaluated these observations, I realized that the placement of the digit (writing it on the chalkboard) may have been a confounding factor. In the course of normal classroom procedures digits written on the chalkboard always have quantitative significance.

The respective digits, "4" and "6", had no visual context to which the children could look for clues. There may, however, have been a "usage" context to which they related when they cited examples of the usage of "4" and "6".

Perhaps T shirt numbers are a more accurate source to use to determine a child's thinking regarding the use of numbers.

To Be, Or Not To Be

A recent issue of SEEDBED contained a provocative article concerning the practical aspect of constructivism.

The author concurred theoretically with Piagetian concepts of development, but questioned the practicality of teaching in a heuristic manner. The main point of contention was the amount of time required to determine the developmental level of thirty children and to address the individual needs of so many students.

The author cited the difficulties of having a second job and the responsibilities of caring for a home and family as immediate reasons why the extra time and energy were not available. These are arguments that cannot be ignored. They are of primary importance to all of us teachers who have families and responsibilities.

As a wife, mother of four, kindergarten teacher, taxpayer, mortageower, parent of two sons under 25 years of age, parent of 2 sons who are presently attending or who will enroll in college in the fall, I commiserate with the author. I can't help him financially but I can offer some suggestions which might help him professionally.

As a practicing constructivist, I would like to share some of my thoughts about heuristic learning. The application of Piagetian theory in the classroom is not the systematic, concise sort of thing one finds in a flow chart in a teacher's manual. There are no defined, prescribed skills to be mastered by October 31st. There are no behavioral objectives. There are very few confused, obstreperous children to contend with.

This method of facilitating children's learning is not one that can be best learned in college classrooms. The Piagetian theory of learning is one which requires time. One must read and read and read and childwatch - systematically or unobtrusively at every opportunity. Reading can be done while waiting for a son who is at wrestling practice, while cooking supper, at lunch time, or under the hair drier. This is perhaps where the greatest amount of time is needed.

The other requirements, or prerequisites for constructivist teaching are as follows:

1. One must have an immense concern for children.
2. One must have an insatiable desire to discover how children learn.
3. One must have the courage to relinquish the role of authority figure; one must become a learner.
4. One must have a support system (Teachers' Center)
    a. to discuss problems.
    b. to share ideas.
    c. to expand thinking.
5. One must have an overpowering need to see children succeed.
6. One must have the self-confidence to admit that he does not know all the answers.
7. One must have the patience and fortitude to allow children to "do it myself" and, perhaps, fail then try again.
8. One must be resolute in his determination to teach in a heuristic manner (in spite of peer comments).
9. One must take every opportunity to explain what he is doing and the theory behind it, if necessary.

10. One must not expect perfection the first day, the first week, nor the first year. To fail is to learn.

These are a few of the many prerequisites for a practicing constructivist. There are many more that could be added to the list, but there is no infallible checklist to follow. Learning is a very personal thing. British educators have said that a written curriculum for teaching based on Piaget's theories is tantamount to the destruction of the very thing one is trying to achieve. There is a spontaneity that is mandatory in learning which is killed when a learning "experience" is structured.

A practicing constructivist must constantly be learning, observing, and discovering. The time required is the time that is commensuate with one's concerns, responsibilities, and obligations. It requires no more time - probably less - than making out lesson plans or flow charts or grading a stack of scribbled papers only to come to the realization that one is still oblivious to the child's problems.

There is no one answer. Each teacher must identify the issue, evaluate the alternatives, and find the solution that is the best for him and his students.

What Do I Teach Them And When Do I Teach Them?

When should the following concepts be introduced:

1. Subtraction,
2. Unit measurement,
3. Chemical actions and reactions, and
4. Decoding of written symbols?

Teacher: Class, does everyone have what he needs for our work today?

The children pursue the items on the table and verify that all have the necessary items. One of the pieces of equipment is a container with twelve compartments.

Teacher: Everyone may begin their work. Do a thorough job.

The children begin working on the project, comparing results, questioning each other and verifying specific findings.

Daniel: I need five more. (He is looking at the sectioned container and seems concerned because several of the sections are not full.)

Teacher: Why do you need five more, Daniel?

Daniel: Because I have five empty places.

Teacher: Does everyone have sections that are empty?

The children confer after inspecting their own containers. They confirm the fact that each child has a container with five sections unfilled.

Teacher: How many sections are complete?

Every child counts - 1,2,3,4,5,6,7. The total sections completed is equal in all containers; the individual arrangements of the items in their respective containers is very diverse.

Teacher: Can you each arrange the items so that we will know how many sections of each container are filled without having to count each individually?

Teacher: How many items will be needed to fill all the sections of your container?

Tim: Twelve, I think.

Shane: Seven and five more make twelve.

Tim: Twelve take away five is seven.

Sariah: No, twelve take away seven is five.

All attention is directed toward the individual container in front of each child. Fingers are busily pointing and numbers are verbalized in great profusion.

Jamie: I think they are both right.

Teacher: Can we indicate the quantity of twelve in another way?

Tim: 1, 12 - (pause). A dozen, a dozen!

Teacher: Look on the top of the container - the outside of the top. Does it say "dozen" anywhere on the top?

Andy: (He points to the words.) ONE DOZEN.

The containers vary in color and in context, but all the children are able to find the term "ONE DOZEN" on his respective container. Some of them go on to read other words which they recognize on their boxes. Many also find other numbers indicating the weight and size of the contents of the box.

Teacher: If there were twelve children in a line, could we use another word to describe the total number of children - another way of saying twelve children?

Phillip: A dozen. Twelve is a dozen.

Teacher: Let's go back to the original problem. Daniel said that he needed five more items in order to fill his container. Do we have enough items for everyone to have twelve?

John: I brought six. That's not enough.

Mike: I brought twelve. That's the same.

Andy: I forgot mine.

Teacher: Do we have enough for everyone to have twelve?

Jamie: I guess not.

The children continue working on the original project. As the teacher observes their progress she hears John discuss a problem with Jamie.

John: Yours is different. How did you make yours come out like that? We don't have that kind at our table.

Jamie: (Very nonchalantly) You put this and this together. That's how I got it. It's simple.

John puzzles momentarily and then returns to his table to verify the statement made by Jamie. Judging by the results of his work, the experiment was a success.

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The kindergarten children in Portable 003 had had a lesson in addition and subtraction; they had learned about a unit of measurement, a dozen; they had done a good job decoding written symbols; they had experimented with liquids of various colors and had verified their results. It was an activity that all the children could participate in. It was fun. And, most importantly, they all had seven beautifully colored Easter eggs to show for their effort.

T Shirts/Required Reading

How do children learn to decode written language?

How do children perceive written language?

How do children learn spoken language?

Are phonics and the alphabet the keys that will unlock the door to proficient reading when children have reached the level at which they are able to understand abstractions?

How do children learn to decode the following words:

K-Mart
Coke
Pepsi
Alphabits
School
Stop
Crest
Pac Man

Do children recognize the individual letters of the alphabet and then the phonetic components of each word in order to say the words?

Do children begin their years of formal education completely oblivious to any form of written language?

Do children learn spoken language by bits and pieces of sounds which they learn to combine in order to produce a word which is meaningful to adults? Babies in the initial state of learning certainly experiment with various sounds, but as spoken language is learned children say whole words, not parts of the word.

Why do children learn spoken language so quickly?

Is it possible for children to learn written language in a manner commensurate with the way in which they learn spoken language?

Are young children merely empty containers which must be filled with knowledge about the alphabet and phonics in order to decode written language?

Is it feasible to think that young children approach learning in a systematic manner that may not be discernable to the adult, but is, nevertheless, very efficient for learning at the preoperational level of development?

Do adults know how children learn written language?

Pedagogues have traditionally been concerned with subject matter, rather than how children learn. There are many theories regarding the most expedient methods to be used to teach what adults perceive to be the essential components of language. Adults who have achieved language proficiency view language acquisition as a part-whole relationship. Young children who are just beginning to perceive written language are global thinkers. They look at a page of writing in its entirety. As educators come to realize that the prime concern of education must be the learner, not the material to be learned, they become more aware of the need for research to discover how children learn written language.

Emilia Ferrerio, Constance Kamii, Mieko Kamii, and Hermina Sinclair de Zwart have been doing very extensive investigations in order to discover the methods children employ when they are learning to decode written language.

In a paper by Hermina Sinclair de Zwart, "Children's Ideas About Written Words and Written Numbers", DSRE, March 1982, she stated that children must reinvent and recreate the symbolic systems of their respective societies. Children look for patterns, for consistencies, for differences, and for similarities. Their constructions are far different from those of an adult, but there is an internal consistency which is the basis for the reinventing and the reconstructing which they will be able to achieve.

of Hazzard", and "Pac Man" are far more important words to be able to decode than the words in a reading book to which the children cannot associate in terms of their real world.

One particular source of environmental print can be very helpful to facilitate many and varied learning activities in kindergarten. It has been the basis for observing the developmental level of thinking of children and it has been the vehicle for activities involving likenesses and differences and classification. It has expedited many open-ended activities that help expand thinking. It is something that changes each day and each day provides new problems to be solved. It is a source or writing that involves any child and every child. The source for all this learning is a T shirt.

The following activity elucidates the manner in which T shirt reading can evolve into many other types of learning activities.

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All the members of the kindergarten class participated in this activity. It began because one of the children noticed that two of the boys were wearing T shirts that were very much alike.

Krystal: They got white and blue. They're muscle shirts.
Joe: They both got blue.
Pete: They both got red.
Phillip: John got the most red.
Krystal: Both got a word.
Teacher: Is it the same word?
Daniel: Different.
Teacher: How many words are there on John's shirt?
Jason: Two.
Krystal: Two.

Teacher: How many words are there, John?

John tries to examine the T shirt to find the number of words, but he has a disadvantage because he must look at them upside down.

Krystal: Two. (She repeats her observation.)

Shane: Three. (He counts "Dirt Rider" as one word; the letter "y" as a second letter; and the initials of the artist as the third.)

David: Five. ("Dirt Rider" is designated as one word; the helmet the bike rider in the picture is wearing is the second word; the side of the motorcycle pictured where the manufacturer of the bike is imprinted is the third word perceived; the letter "y" is pointed to as the fourth word; and the initials of the artist is the fifth.)

Teacher: How are the shirts different?

Jamie: They both got a different picture.

Krystal: John's shirt has white lines. Jason's shirt has red lines. Light blue and dark blue.

John: That white doesn't go (all around).

Phillip: That line goes all around the shirt. (Pointing to the other shirt.)

The activity now changed to one that the children were very familiar with. It is an exercise which facilitated visual acuity, classification, and recognition of differences and similarities.

The children must discover what the similarity is that the leader is thinking of.

The first leader is the teacher.

Teacher: What am I thinking of that both T shirts have that is the same?

Jamie: Both got blue.

Teacher: Yes, they both have blue, but that's not what I am thinking of. Can you find another thing that is the same?

Jamie: Both have orange.

Shane: Orange? No where.

Jason: Both have letters.

Jamie: Both.

David: Same shirts!

Class: (in unison) No.

Krystal: Both have short sleeves.

Teacher: Yes, they both have short sleeves, but that is not what I am thinking of.

Jason: Both long shirts.

Class: No.

Sariah: Both have blue shirts.

Jamie: (very confident that Sariah must be correct because her thinking concurs with his) She's right. Both have the same color.

Teacher: Yes, that's what I was thinking of. Jamie, will you be the leader now? Pick someone who has something about their shirt that is like your shirt. We will try to guess what it is.

Jamie chooses John.

Krystal: Both got a picture.

Jamie: No.

Traci: Both have words.

Jamie: No.

Shane: Both have strips.

Jamie: No.

Joe: Both have blue shirts.

Jamie: Yes. It's the color.

Jamie joins the others and John picks Phillip.

Jamie and Sariah: Both got blue.

John: Both have blue. I have a blue name. He (pointing to Phillip's shirt) has a blue number.

It is now Phillip's turn to decide on a child who is wearing a shirt that has a quality similar to something in his shirt.

Krystal: Both have black hair.

Teacher: Remember that we are only looking at the T shirts that the boys are wearing.

Jamie: Both got grey.

Phillip: Both got grey and blue. (A partially correct response is sufficient for Phillip.)

David now chooses Shane.

Jason: Both got blue.

David: No.

Krystal: Both have lines.

David: That's right.

Shane now picks Daniel who immediately observes that:

He's got some numbers.

Daniel is referring to the print on Shane's shirt that says, RUNNER-UP. Shane acknowledges the comment and points to the words "Runner-up" on both his shirt and on his shorts.

Pete: Both have "R's". (This is correct.)

Shane: No. (He is thinking of something else.)

Tim: Both have letters in a box.

Krystal: Both have men.

Daniel: He has more men. (Daniel points to the shirt of another child in the class.)

Tim: Same color.

Shane: Yes.

Teacher: What color do you mean?

Jamie: (who again is confident he knows the reason) points to the blue letters on each shirt.

Daniel picks Mike.

Krystal: Both have lines.

Tim: Both have short sleeves.

Daniel nods his head affirming both observations. It has become apparent that the class thinking was restricted by their inability to focus their thinking on clothing alone.

In order to include all the children, the teacher asked one of the girls to take the next turn.

Teacher: Sariah, pick someone to come up that has a T shirt with something on it like yours.

Sariah chooses Traci.

Jamie: Both have short sleeves.

John: Both have stripes.

Sariah: (Nods her head affirming the correctness of both.)

Traci chooses Shane.

There is some consternation among the children because one of the participants is a girl and one is a boy. It is obvious to the teacher that there also exists some confusion concerning the meanings of several pronouns.

In order to facilitate understanding about the meaning of personal pronouns, the teacher asks all the "he's" to stand up.

Teacher: All the "he's" sit down. (Most of the boys comply.)
All the "him's" stand up. (All boys stood up, now.)

Jamie: "He's" and "boys" is the same thing.
"Him" is "boys".

Shane: "Him" is a boy.

Daniel: All girls are "her".

Teacher: All the "her's" stand up. (All the girls stand up. Two of the boys hesitate, but do not stand.)

Teacher: All the "her's" sit down. (All the girls comply.)
All the "she's" stand up. (Once again the girls stand. None of the boys stand.)

Teacher: All the girls stand up. (There is no problem with this classification term.)

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T shirts should be required reading. In the short span of time which was needed for this particular activity cited above, the teacher was able to observe several pertinent developmental characteristics of individual children and of the class. The activity also facilitated interaction among the children in a constructive, nonthreatening manner. Those children who were more mature stimulated the thinking of those who were yet unable to relate to written language. It was an activity that all the children were interested in doing, but it was an activity that gave each child an opportunity to participate.

There were no right or wrong answers. All thinking was accepted, although it was sometimes questioned.

Unlike standard classroom procedures, T shirt reading allowed all the children to express their ideas freely. Those who were less mature had an opportunity to be a leader as did those who, in other situations, may be the children that always know the correct answer. No one achieved because another had failed.

T shirt reading may neither be the most advantageous means to facilitate decoding nor the most scientifically acceptable method of learning, but it is ubiquitous, interesting for the children, and adaptable for open ended activities in other areas of learning. T shirts should be required reading at all levels of learning.

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Things I Know Based On Things I've Seen

1. Preoperational children must be able to distinguish between written language symbols and written numerical symbols before they can verbally explain their thinking about the usage of written numbers.

   Younger children either do not understand number usage, or they are not developmentally ready to be concerned about the use of written numbers.

2. Quantitative usage is the one to which they are introduced (written symbols) when they first enter school.

   Quantitative usage is the one which children verbally experience first - "How many fingers does Johnny have?"

   "Tell the nice lady how old you are!"

3. Measure usage (cost) is a very obvious and important part of a child's everyday environment -trips to the grocery store; large, colorful signs; TV.

4. The ability to classify by only one criterion, later two, may be a restrictive factor when a child has to determine numerical usage. Written numbers in a particular context may be perceived as having one, and only one, usage.
   a. Numbers on a hop scotch game cannot have quantitative meaning.
   b. When children are being counted to find "how many", one of the children will say, "I can't be 11, I'm 4."

      (This is an example of verbal numerality. The confusion for the child is even more evident if he is given a written number for 11.)

Problem: How do children determine the usage of numerical symbols?

Procedure: A random selection of environmental print which contained words and numbers was shown to the children. Each child interviewed was asked to identify what he perceived to be a number and to explain the meaning of that number. The children were members of a kindergarten class. The interviewer was their teacher.

David was shown a box of straws.

David: Straws. Right here (are numbers). (He pointed to a code number on the box.)

Teacher: What does the number mean?

David: It means there are numbers there.

Teacher: Are there any other numbers on the box?

David: Here is some. (He points to the numbers 50 and 7 3/4.)
Numbers there too. (39¢)
There's a number 50 on the edge.

Teacher: What does the 50 mean?

David: Means how many this costs.

Teacher: What does this number mean? (7 3/4)

David: 7,3,4; means numbers of this word. (points to adjacent word)

The next item shown to David was the heel of a shoe which had three numbers on it.

Teacher: Are there numbers on the heel?

David: Here, there, and there. (David points to the three numbers.)

Teacher: What does this number mean (10)?

David: Cause the numbers.

Teacher: What does this number mean (27)?

David: 27. 'Cause there had to be.

Teacher: Why?

David: That's the number that has to be on there.

David was shown a printed graph.

Teacher: Where are there numbers in this picture?

(David points to all the numbers on the graph.)

Teacher: What does this number mean (46.88%)?

David: 'Cause this has to be on there to show you where the mountain is (referring to the jagged line of the graph).

(David looks at the numbers again and says 4,6,80, which he then changed to 46 and 88.)

Teacher: Are there any other numbers on the page?

(David points to the other numbers on the graph.)

The teacher then points to "page 2" and again asks David what it says.

David: Says 2.

Teacher: What does the 2 mean?

David: How many things there are.

Teacher: What things?

David: Toys, bells, bathtubs, about monsters, cats, about boys and girls, womens, moms and dads, about fruit and watches, orange juice, dresses and shorts and shirts and cowboy hats, words, and these (heel).

The next item is the Magazine, a supplement of the Sunday newspaper.

Teacher: Do you see any numbers?

David: Only number here is this (points to May 1-2, 1982).

Teacher: What does it mean (May 1-2, 1982)?

David: 1,2,1982. How many numbers there are. Should I turn the page and look inside?

David turns the page and sees an advertisement for typewriters which he identifies as tape recorders. The ad has $25 in large print to which David points.

Teacher: What does that mean?

David: How many tape recorders there are.

Teacher: Are there any other numbers?

David: Here's a number (page 81). It's the number of the page.

Teacher: Are there any other numbers?

David: Here (1982) and there (49351). It says how many doggies there are.

The next thing is a Lucky Charms box. The back side of the box has a picture of a target on which appears numbers. There is also an offer which requires $3.50. David cites the numbers on the target and also the $3.50. He says the $3.50 is how much "it" costs. He then notices the numbers on the side of the box which indicate the nutritional content of Lucky Charms cereal. He says that those numbers tell how many words there are. Having indicated that 25% on the box is also a number which he reads as 25,0,0, he explains that the numbers tells how many numbers there are.

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Sheila is the next child to be interviewed. She is shown the same box of straws that David used.

Teacher: Can you find any numbers?

Sheila: 50.

Teacher: What does the number mean?

Sheila: It's a fifty number.

Teacher: Why is the number on the box?

Sheila: I don't know....because it helps you know what 50 looks like and how to count it.

The next number that Sheila sees on the box is 39¢ which she says means that "you count to 39".

When she is shown the graph she points to the number 42.

Sheila: So you know how much it's getting up to today from the weather.

Teacher: Are there any other numbers?

Sheila: (pointing to the number 40 on the same graph) Like if it's 40° outside if it's raining you know you have to stay in.

On the Lucky Charms box Sheila pointed to the number 20 on the target. She explained, "It means if you get "it" to that one, you don't win the game."

She then pointed to the number 10 and said, "It means a ball is in the Lucky Charms box."

For the number 40 she said, "When the ball gets on the 40, what it means is that you win a Lucky Charm."

When Sheila looked at the Magazine supplement of the Sunday paper, she pointed to the number 4 (page 4).

Teacher: What does it mean?

Sheila: It means she (the lady pictured on the same page) has 4 pairs of clothes.

Sheila: (pointing to the $25 in the ad with the typewriters) It means that you have to put in paper and send it to 25 people.

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The next child, Sariah, is shown the graph. She points to 43.13% to indicate that it is a number.

Her research has elucidated the fact that the ability of a child to be a competent reader depends primarily on his understanding of the "meaning and the principles of the notational system."

Emilia Ferrerio in her recent research has found that young children establish very systematic patterns of perceiving written language. Young children believe that most written symbols are labels and that no conformation of less than three squiggles can be read. They also are visually capable of seeing a whole page of writing before they are able to distinguish a paragraph on that page. The next step is the visual recognition of a sentence, then a word, and, finally, the individual letters in a word.

Children are constantly looking for consistencies in written language, as they do in spoken language. Anyone who has observed the speech of young children is aware of the systematic approaches which are obvious in a child's use of "mouse", "mouses"; "foot", "foots", or "feets". When they are aware of a small number of letters, such as those in their names, they use permutations of those letters to "write" other words. A letter to a friend is "written" in a far different manner than a list of items to be purchased from the grocery store.

In kindergarten class one day one of the children was quite concerned because the system he was using to interpret written language was upset by some writing the teacher had done on the chalkboard. The teacher was writing some sentences that the children were dictating concerning a recent activity. There were five sentences written on the board. Each of the sentences was complete in one line except for the first which required two lines of writing. The question the child asked was, "Why isn't there one there?" He was referring to the absence of a period at the end of the first line of writing. He had seen the pattern of a period at the end of each line of writing and then had come to the realization that one of the lines of print did not fit the system.

Can environmental print facilitate decoding of written language?

Hermina Sinclair de Zwart believes that emphasizing environmental print is not a significant approach. Rather, educators should address the developmental steps children use to construct the notational system of their society. She feels that "internal construction strategies are more important than imitative learning from environmental input."

Environmental writing can, however, introduce children to the meaning and to the many ways in which words and numbers are utilized. Words which are easily identifiable by children can help them recognize likenesses and differences and enable them to see visual regularities of words.

Children realize that words are labels for things. They are intuitively motivated to decode language in their environment. They are aware of the differences in words as they attempt to decode environmental language.

As the search for a true understanding of how children learn written language continues, environmental input can be a useful tool because children are aware of it, because children are interested in decoding environmental print, because it is ubiquitous, because it relates to the real world far more than much of the prescribed textbook literature does at the present time. "Star Wars", "The Dukes

Teacher: What does it mean?

Sariah: I don't know. For the weather or something.

Sariah then points to the number 46.88% to indicate that it is also a number. When asked to explain what it meant, she says, "I don't know. (They) just wanted to (put it there.)"

On the box of straws Sariah found the code number and said it was "to see how much something is".

Problem: How do children determine the usage of numerical symbols?

Procedure: The children were interviewed individually. Each child was asked about a graphic representation of language and of numbers. He was asked to explain what each example meant and why it was on the box.

Environmental print was used such as cereal boxes, a cracker box, a plastic lid, a bill of sale, a TV guide, an advertisement for a grocery chain in a newspaper, etc. The children were members of a kindergarten class. The interviewer was the kindergarten teacher.

Jamie was asked about the number 18 on a Nabisco Shreaded Wheat Box.

Jamie: 18, could tell how old you are.

Teacher: Why is the 18 on the box?

Jamie: (shrugs her shoulders) To see how many boxes there are.

Teacher: What is this for ($1.31)?

Jamie: To see how much it costs.

Teacher: What is this for (code on the top)?

Jamie: I don't know.

Teacher: What is this (nutritional content percentages)?

Jamie: In case you want to write them.

When shown the figure 25% on the Lucky Charms box Jamie said it meant, "How many pieces there are".

A coupon on the same box had Box 353 which Jamie indicated, "says address".

The number 36 on the box was to "see how much letters there are".

The numbers indicating the nutritional content were, "to see how much cereal in it"; "how much letters".

The code on the Krispy Crackers box was explained by Jamie as:

"how much letters there."

"to see how much letters there are all over the box."

On the plastic lid the code numbers used for scanning were explained by Jamie as "numbers to tell how many circles are there".

"to see how many lines there are".

52% on another lid were "for how many straps".

95115 on the edge of the lid were "to see how much it costs and to see how much letters there is".

2 lb. size were "to see how much circles there".

****

Randy was shown Feb. 071A on a container. He said it was "the price of thing."

For 60 percent oil he says, "I don't know."

On the side of the Cheerios box he noticed a coupon. When asked about Box 139 he said, "I don't know." "I can't read."

Zip code 33460 - "I don't know." (He quietly falls off his chair.)
$12.95 - "Price for food."
Net wt. 14 oz. - "I don't know what it's up there for."
9 x 12 (on a bill)- "I don't know."
1097 - "I don't even know these.(points to the cereal content numbers)

****

On the Cheerios box there was a picture of some books and the number $12.95.

Scott: It means that many books. Only that much is there.

Teacher: Scott, show me a number.

Scott: $3.75 is a number; just a number. It don't tell anything. (pause) Says how much these things are.

Teacher: Are there any other numbers?

Scott: (pointing to the 7 in the price $3.75) 7 is how much these things are.

Teacher: Are there any other numbers?

Scott: (points to the 5 in the price $3.75) Tells us how much these are.

On the Count Chocula box Scott points to a number 4.

Scott: Tells how many bubble gums are in the box. (There are pieces of bubble gum illustrated on the box.)

Scott points to pictures of ghosts on the box. He says that the 4 also is how many ghosts there are. He counts the ghosts and finds there are five, not four. He reconciles this discrepancy by explaining, "The fifth one is an illusion. It disappears at night."

Net wt. - 12 oz.	-"means 30 pieces of bubble gum."
340 grams	-"means something."
74 (on the side)	-"tells how many boxes there is."

****

Mary was shown a copy of the TV guide which had the numbers 1-7 in the top corner.

Mary: That's much money. Mom told me that you would have payments on it then you buy it free.

12:00 - 30 is the next thing Mary is asked to explain.

Mary: In case somebody dies they might be that much years old.

The numbers on a map in a newspaper are explained in the following way:

Mary: That's a different world. This is a way in case you don't know it. In case you want to go to a different world. Just don't want to go to another. It's a mystery!

$1.19 in a Kroger advertisement is explained in the following way:

Mary: Says Kroger.

The 39¢ Mary says is "how much money it costs to go to that city."

$1.89, Mary explained, was "how much food costs, something like meat."

When shown a chart in a newspaper Mary said, "There could be some food that somebody bought. That's how much it cost."

The coupon on a cereal box had Box 192 imprinted on it.

Mary: How much cereal costs if they sell the rings (pictured in the ad.)

Net wt. 16 oz. - "how much cereal costs."

Bill with 4-27 - "when crackers are no good they give you your money back."

1097 - "how much crackers cost."

$2.29 on cereal lid - "how much it costs."

Code number for a scanner - "how much in case something comes up - owe it to you."

****

Steven was shown the Lucky Charms box which had a picture of a cowboy on it. 25% on the box, he said, was "about a cowboy."

For Box 353 he said, "Cause."

He said 39¢ in the Kroger was on the page because somebody "wanted to" put it there.

Problem: What does a preoperational child perceive the usage of a written number to be?

Procedure: Five children were asked individually to explain the meaning of specific numbers the teacher showed to them, one at a time. The children were interviewed separately, but one or two others watched and commented from time to time.

Background: The chronological ages of the children were from five years, 10 months to six years five months. They were all members of the morning class public school kindergarten and had been together for eight months in kindergarten. Previous to their enrollment in kindergarten they had all attended the same pre-school program. The kindergarten environment was very unstructured. They were very free to respond. The kindergarten teacher who was the interviewer presented the numbers and recorded the comments.

Written numbers used: 1618 (a number on a house)
877-1098 (a telephone number - the teacher's)
5 (the age of most of the children)
28 (the number of the day - a calendar for each month covers one wall of the classroom. The children are aware of numerical symbols on the calendar.)
30 (miles per hour)
12 (the number on the clock which is hung at the eye level of the children)

****

The teacher showed the numbers, 877-1098, to Jamie and asked her to explain what the number meant.

Jamie: Numbers! (expressed rather quizzically)

Teacher: What do they mean?

Jamie: Phone numbers.

Laura: A bill.

Teacher: What is it a bill for?

Laura: For your phone numbers.

Teacher: For your phone numbers?

Laura: For phone. I don't know what they mean. Like how old you are!

Jennifer is given the number 1618 by the teacher.

Teacher: Jennifer, what number do you have?

Jennifer: (she reads each of the numbers on her card) One, six, one, eight.

Teacher: What does your number mean?

Jennifer: Like a code. Is it a code? (The teacher does not reply.) Could be zip code? Could be a telephone number, too.

Teacher: Is it like Jamie's number (877-1098)?

Jamie: (volunteers) No.

Jennifer: Could be part of a phone number. Could be my cousin's. Can't call the number. My cousin doesn't have a phone.

Teacher: Jennifer, tell me about your number.

Jennifer: Start of something new.

Teacher: What is the something new?

Jennifer: Dates on the calendar. Could be!

Teresa: (agreeing) Calendar numbers.

Jennifer: Counting numbers like 1,2,3,4.

Teacher: What is a counting number?

Jennifer: Counting like 1,2,3,4,5,6,...(Jennifer said all the numbers in the correct order until she reached 49. At that point she repeated the numbers from 40 to 49. She realized her mistake, went back to 1 and counted to 39, left out 40 through 49 and then said 50.)

The other children at the table joined in at 50 and they all continued the count together until they reached 114, 116, 117, 119.

Jennifer: We're done!

Laura: (looking again at the number 1618) Is that how old that is?

The next child was given the number 30.

Teacher: Laura, what number do you have?

Laura: 360, I mean three, zero. I don't know how old that is. (pause) You could buy a lot of suckers with how many these are.

Mary: 30 suckers.

Teresa: Jamie told her (Laura).

Laura: You could find 32 play cars.

Teacher: Where is the number 2?

Laura: I forgot; I mean 30. I like counting.

Teacher: Why do we need to count?

Laura: To buy how many you want - 400, 43 thousands

Jennifer returns to the original task.

Jennifer: 1.6.1.8.

Teacher: Where do you find numbers like that, Jennifer?

Jennifer: At the North Pole or at the South Pole.

Laura: (sighing very deeply) I'm almost dead! If I do one more I'll be dead.

Teresa: (still concerned about the number 1618) On a stop light.

Jennifer: Something that's push button - then it's straight down.

Mary has the next number which is 12.

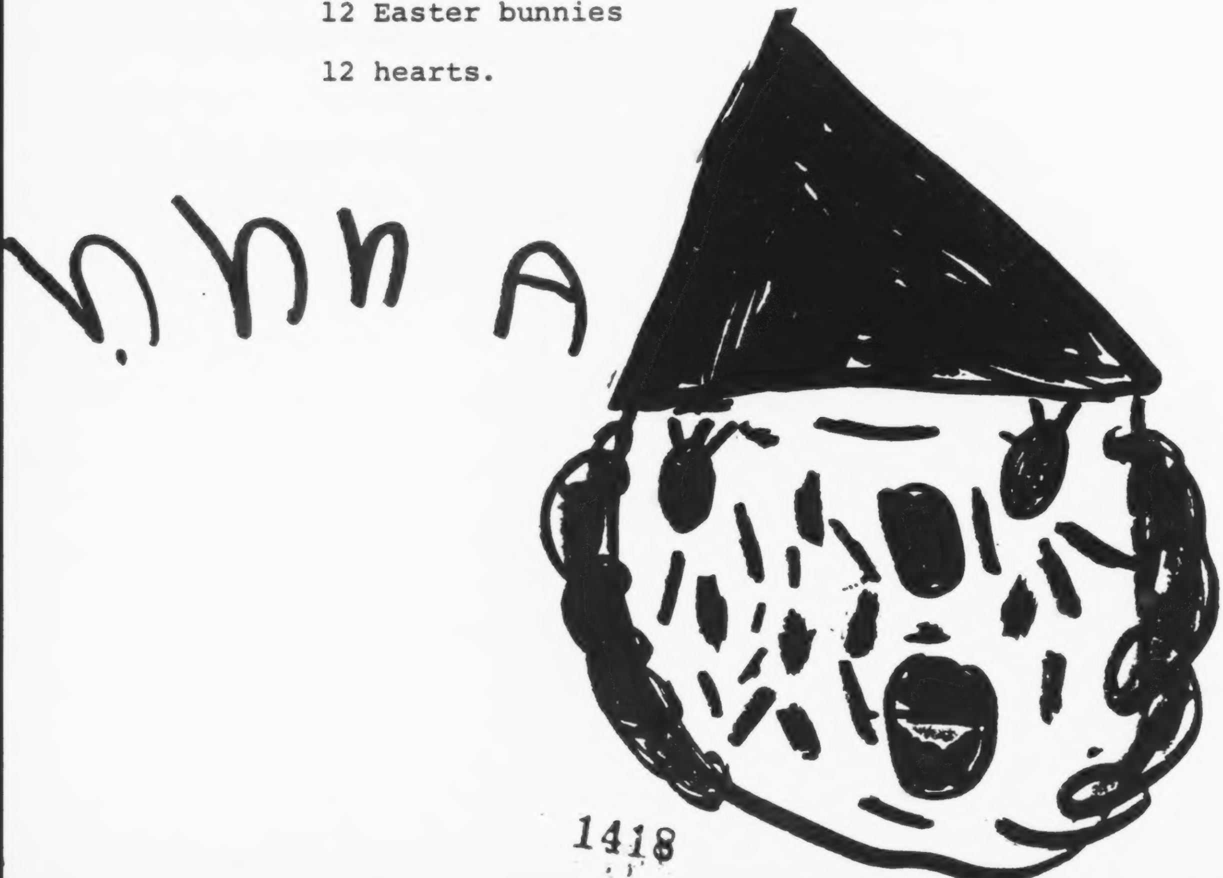
Mary: 12, you could buy 12 cokes. What kind?

Teacher: What kind?

Mary: Chocolate.

Jennifer: you could get pieces of bubble gum.

12 glasses
12 watermelons
12 swimming suits
12 pools
12 Easter bunnies
12 hearts.



1418

Journal for March 1 - March 8

Observation 1:

If I continue writing articles and concentrating on observations I have made of my student's learning processes, I will not be prepared for the presentation on Saturday!

Observation 2:

The kindergarten has had to do some thinking about written symbols. While doing some directive (excuse the expression) teaching, I found that Jamie knew that the written symbol 10 meant one more than the written symbol 9. He added that the symbol 11 meant 1 more than the symbol 10.

I drew 11 triangles on the chalkboard. He counted the shapes and wrote the number 11 to indicate the quantity.

I asked how he could make 12 triangles.

He proceeded to draw 12 triangles and wrote the number 12 beside the new row.

Was it the manner in which I phrased the question that illicited this response?

I assumed that he would add one more triangle to the row of 11 and change the written number to 12.

I learned: 1. One must never assume.
 2. Preoperational thinking is based on visual perception.
 3. I had better be more careful when I give directions.

Observation 3:

John looked at me with the most delightful, self-satisfied smile on his face and said, "I knew that there were 6, and I didn't even count!" He was referring to an item that had 6 dots on it.

Observation 4:

Our room has two bathrooms, now known as bathroom #21 and bathroom #27. Previously they were called the boys' bathroom and the girls' bathroom. Jamie noticed that the calendar numbers at her eye level are #21 next to one of the bathrooms and #27 next to the other one. I wonder what she will say next month when the calendar numbers are rearranged?

Observation 5:

I used the small colored rods in the box with one class. They were asked to specify the color they were going to take out of the box. Again there was no comment about the ability to determine a color if one could not see the colored pieces.

Results: 6 chose blue, 4 took out blue
8 chose red, 6 took out red, 1 took out orange
1 chose yellow, 1 took out yellow

These were the comments:

1. "I felt and rolled them around."
2. "I moved them around and felt it."
3. "I felt the color."
4. "I felt it."
5. "I could feel it."

I used the longest and the shortest of the seriated set. The children were to take out the longest stick.

Correction: I used three sticks, the longest, the shortest, and the middle size.

4 children were asked to take out the longest stick.

2 did

2 did not

4 children were asked to take out the smallest stick.

2 did

2 did not

4 children were asked to take out the longest and the shortest stick.

3 took out simultaneously the longest and the shortest sticks

1 took out the longest stick, but not the shortest one

With a choice of sticks three sizes, no one was able to take out one of each size simultaneously. That was as many as they could hold in their hand at one time.

Observation 6:

I have done some very interesting counting-on type of activities somewhat in the manner Dr. Labinowicz described. I need more time to write this out. Must stop now......

A Small Child's Eulogy

Krystal returned to school after an absence of several days. Rather pensively she explained her absence by stating that she was out of town because her grandfather had died. Nothing more was said that day. Her demeanor was constrained, but she joined her peers in their activities and, for a short time, seemed to lose herself in the security of immutable familiarity.

The next day, after she had completed the work assigned by the teacher, she was told that she could write whatever she wished. The teacher would write the words she did not know and she would copy them. In a very gentle voice Krystal requested the following words and copied each one very lovingly on her paper:

"I wished my grandpa didn't die."

******

Grandpa

"Take care of my grandpa. He died."

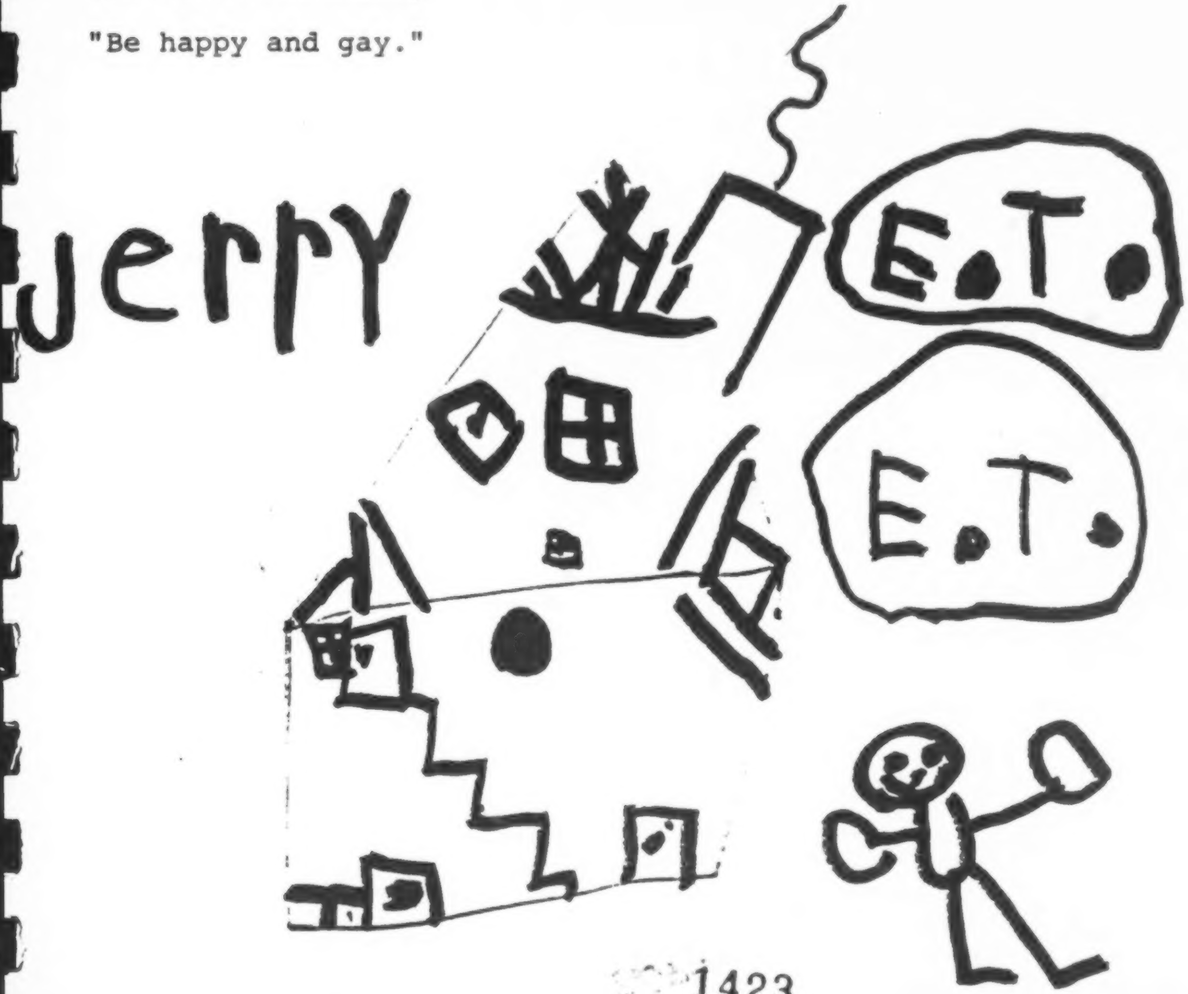
******

A small voice whispered softly as I finished the last letter, "He's up in heaven."

FIVE LITTLE BUTTERFLIES

(Composed by Logan Kindergarten students)

Five little butterflies, happy and gay,
The first one said,
"What a beautiful day."
The second one said,
"Let's fly away."
The third one said,
"Aren't you glad it's May."
The fourth one said,
"Let's go play."
The fifth one said,
"Be happy and gay."



OUR CLASS

(Logan Afternoon Kindergarten Class 1979-1980)

In the merry month of May,
Robert likes to go out to play;
Donald likes to pick flowers for Mother,
Or play baseball with his brother;
Michael Dockery broke his arm one day;
Coming down a tree the wrong way;
Roller skating Nicole loves to do,
And jump rope with her friends, too;
Trucks, cars, and motorcycles are Vernie's favorite toys,
Whether he plays alone or with other boys;
Rachael likes to bowl,
Or lay out under old Mr. Sol;
Catrina lays out under the sun,
Eating a big, fat hot dog bun;
Tim likes to play with cars,
Either on earth or on Mars.
Donnie rides his bike;
He would rather ride than walk;
A bicycle is Lance's favorite thing to ride;
He'd rather ride than stay inside.
Doug goes outside each day,
To ride his bike in a very safe way.
On the playground you will find Cary,
Having fun and being merry.

Pat is busy digging for rocks,
He'd rather do this than play with blocks;
On his mini-bike Brad will be;
Each and every day, you'll see;
Gary will be riding his mini-bike, too,
Not in the rain, but when the sky is blue;
Christine outside is playing;
"Hello" to her friends she is saying;
At grandma's Melissa you will find;
Being as good as gold, if you don't mind.
Lea Anne likes to ride her bike,
In the morning, afternoon, but not at night;
Swimming James will be,
In a pool, not in a tree;
Kevin likes to go to the park,
To swing or slide or run 'til dark.

Dear Parents,

Since everyone is interested in "do-it-yourself" projects, I thought you would like to know the children in the afternoon class do certain things.

Brad Dickey gave us the following instructions for baking a cake.

1. Put the pan on the oven.
2. Put sugar and icing in it.
3. Put more sugar in.
4. Put butter in it.
5. Put icing in it.
6. Put it in the oven.
7. Turn on the oven; and it bakes.

Pat Maloney told us how to plant a garden.

1. Scrape some dirt.
2. Plant all the seeds.
3. Bury all seeds and then they'll grow.

(Pat recommended planting tomatoes, cherries, and onions.)

This was the way Michael Dockery suggested planting a garden:

1. Rake the yard.
2. Put seeds in the yard.
3. Put onions in the yard and tomatoes.
4. Put in seeds.
5. Put dirt in first.
6. Then put in the seeds.
7. Then put flowers in.
8. Put in onions.

Nicole Wolfe explained and demonstrated how to make a bed.

1. Put the sheets on first.
2. Put the pillow in the pillow case.

3. Put the covers on.
4. On the very top, put the bedspread.
5. Put the sheets and bedspread over the pillow.
6. Tuck under the covers under the pillow.
7. At night time, pull covers back; get in and pull them up.

These are the directions Donald Dunnavant gave us for washing dishes:

1. Put shampoo in the sink.
2. Then clean them off.
3. Then put them on the table.
4. Dry them.
5. Put them away.

Michael Dunham gave us very short and concise directions for brushing our teeth:

1. Put toothpaste on the toothbrush.
2. Brush your teeth.

I hope you will enjoy these very simple and direct instructions given by the children. I thought they did a very good job explaining how to do these tasks.

Helen Miller
(Kindergarten teacher)

Piaget / Individualized Instruction

Individualized instruction does not work. It is stupid to expect a teacher with a class of thirty children to have time to teach each child individually!

Individualized instruction is a totally unrealistic concept that never should have been used by our school district!

I can't imagine who dreamed up that nightmare!

I've seen how those kids in Junior High behave. They're a mess. All they care about is themselves. They are into drugs; they have no sense of responsibility; they have no respect for authority; they have no morals!

The college professors were really into "open classrooms" when we were in college. That's the craziest idea I've ever heard. It certainly doesn't work!

These are direct quotes from teachers. I heard them at a teachers' meeting yesterday.

Is the concept of individualized instruction the cause of our problems in education?

Is it possible that many teachers have been told to "individualize" without having been given an opportunity to learn the fundamental theories that would enable them to understand what individualized instruction meant?

Jean Piaget and individualized instruction are often put in the same box. Consequently, teachers sometimes turn a deaf ear to those who are constructivists and who espouse the theories of Piaget. The hostility with which teachers regard individualized instruction is transferred to the concepts of learning elucidated by Jean Piaget. But many teachers have not read Piaget and know his work only in terms of slogans.

When individualized instruction was the prevailing trend teachers were happy to jump on the bandwagon. As the bandwagon gained momentum, they found that it was difficult to hold on because they had no firm support of understanding. What about this guy Piaget?

Jean Piaget devoted most of his lifetime to searching for the understanding of how children relate to their environment. Many years ago teachers in America jumped on the Piaget bandwagon and inevitably "fell off" because they lacked a firm foundation of understanding. It is time to reevaluate our thinking and to discover the truth about the theories of Piaget.

Jean Piaget did relate many of his findings to the individual child. He used clinical research methods which necessitated interviewing and observing individual children. He discussed the results of his research in terms of the individual child.

As a member of the executive council of UNESCO he was instrumental in constructing Article 26 of the Universal Declaration of Human Rights voted by the United Nations and adopted by General Assembly, December 10, 1948: "Every person (individual) has the right to education....every human being has the right to be placed in a scholastic environment during his formation which will enable him to build until completion the basic tools of adaptation which are the processes of logic." (Piaget, 1948) He went on to elucidate the individual right of each child. "The right to education, therefore, is neither more nor less than the right of an individual to develop normally, in accord with all the potential he possesses, and the obligation that society has to transform this potential into useful and effective fulfillment." (Piaget, 1948)

Piaget was not in favor of the particular trend in education which advocated unsupervised liberty given to children in order to avoid frustrating the developing child. He characterized this type of learning as "generalized play without much educational benefit". (Piaget, 1948)

Piaget admonished teachers to use language that a child could understand. He was concerned that the prime consideration of educators must be the individual child. He did not say that teaching should be done on the basis of one child to one teacher. He did advise teachers to determine the level of thinking of each child in the classroom.

Is this individualized instruction? Does a teacher determine each child's developmental level by questioning the children in the class one by one for a specified number of minutes using a predetermined list of required questions?

Piaget espoused individualized listening. He insisted that teachers stop talking and start observing. He demanded that teachers stop giving orders and start thinking about children who have individual needs and individual systems of learning.

Piaget gave us clues to how children learn about their environment, to how they perceive language and numbers, to how they develop moral judgement and respect for themselves and concern for others. He has discovered the "why's" of children's thinking and has encouraged all teachers to search for the "how" of children's learning.

A teacher can utilize the clues given us by Piaget to evaluate a child's level of development. A child's use of language can be determined simply by taking time to think about the way in which he verbalizes his responses to teacher initiated questions, the way in which he converses with his peers, the way in which he describes something that happened on the way to school.

A child's understanding of numbers is readily determined by watching that child as he collects or counts his lunch money, by observing how he divides a certain quantity of materials among his group - passing out "enough" so that everyone will have an equitable amount.

The manner which a child relates to his environment can be discovered by asking him to tell about a picture he has drawn. The manner in which a child interacts with his peers in the classroom, on the playground, in the hall can be extremely informative.

Many facets of child's development can only be perceived as he interacts with adults and with his peers. Some aspects of his level of development cannot be evaluated unless a child is relating to others.

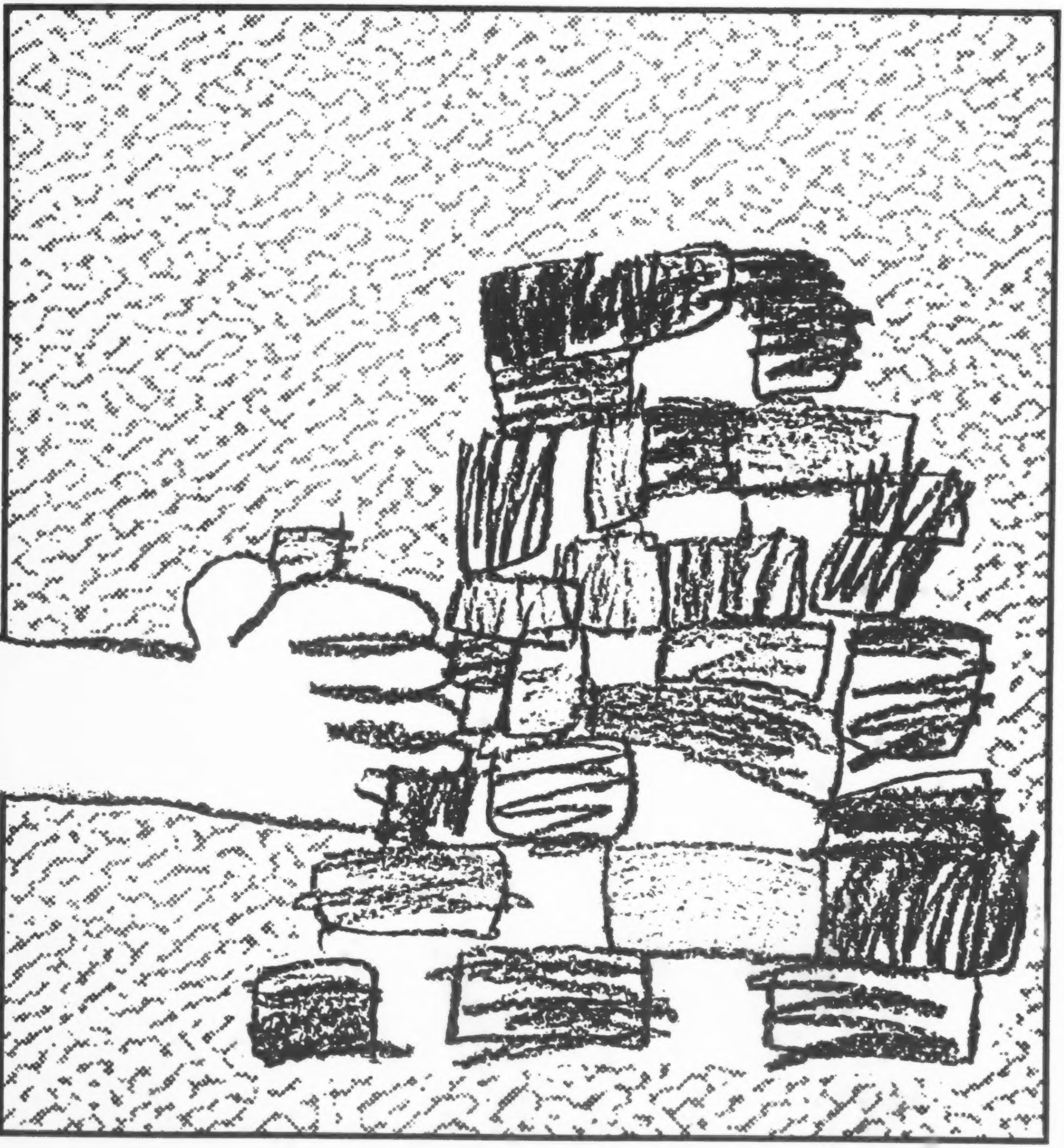
We are very fortunate to have the clues indicating how a child thinks. We are obligated to use these clues to continue the search for some insight into the "how" of learning.

Piaget did not want to have teachers jump on the bandwagon. He demanded that teachers understand his theories. He expected teachers to read and then to observe children. He would tolerate nothing less than the most intense concern and extensive personal observations of children's thinking by teachers. He did not advocate individualized instruction. He exhorted teachers to individualize their concern for children, to individualize their own thinking, to individualize learning for children in order to give them the opportunity "to develop normally, in accord with all the potential he possesses". (Piaget, 1948)

Reference:

Piaget, J. To Understand Is To Invent. N.Y.: Penguin Books, 1948. P. 41, 42, 6.

The children's art that appears throughout this issue of SEEDBED was done by Helen Miller's kindergarten students at Logan School in Granite City.



SEEDBED

SEEDBED

NUMBER 15

January, 1983

Teachers' Center Project

SIUE

**Southern Illinois University
at Edwardsville**

INTRODUCTION TO SEEDBED

As 1982 comes to a close and we hear new stories every day of education budget cuts, teacher layoffs and rising costs, it's easy to become concerned about the future of education.

But as we meet and work with teachers all through the area and see and hear of their work with children, we take heart. These teachers are bright, eager, dedicated people vitally concerned for the well-being of children. We see them encourage and strengthen and spark one another's efforts. We observe their willingness and eagerness to read and plan and develop and share new ideas and materials (all of this after full days in school) and we have hope for education. Our long-held views of teachers as curriculum developers and educational innovators are reaffirmed particularly when we prepare another issue of SEEDBED.

Such has been the case with SEEDBED 15. Read and enjoy what's here, but don't stop there. Try out the ideas and activities. "Bend" them--make them your own--and adapt them for use with your students.

Best Wishes for 1983! Please continue to join us in the view that Knowledge is not a spectator sport!

Thomas C. O'Brien

Shirley A. Casey

21 December 1982
Edwardsville, Illinois

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ABOUT THE COVER

The drawing on the cover of SEEDBED 15 was done by Tina Taylor, a student in Helen Miller's kindergarten class at Logan School in Granite City, Illinois.

Tina was building a round tower with the blocks. Her teacher asked her to draw what she had done. As you can see, Tina drew a picture which is extraordinarily coherent and complex. Those interested in reading about children's art as an index of intellectual maturity might want to take a look at Jacqueline Goodnow's Children Drawing (Cambridge: Harvard University Press, 1977).

PROFESSIONAL DEVELOPMENT

Thomas C. O'Brien

Early in November, we were fortunate to have David Lingard (Northcliffe Comprehensive School, Doncaster, Yorkshire) as a Teachers' Center guest. Late in the week David did several sessions in Urbana at the annual meeting of the Illinois Council of Teachers of Mathematics. His topic was "The Development of Professional Skills of Math Teachers."

There are three aspects to the situation. First, would you take a moment to write down the skills you think important???

Second, we publish a brief list of professional skills David used in his ICTM speech. Compare your list with David's? His list appears on page 36

Third, a lengthy follow-up to David's list and a discussion of the issue will be forthcoming in a future SEEDBED.

PIZZA MATH

Cynthia Presson

Having spent a week hearing how computation drills were a no-no and thinking skills were a definite must, I returned on Monday (two days later) to face my students for this school year for the first time. All ready to cast my math text aside and work on my students' thinking skills, I faced the horrible realization (after spending a day on calendar math) that my sixth grade students knew how to compute, but that they were not very good at it. Worse yet, their money skills were deplorable (Steve did not know that four quarters made 100 pennies or $1.00). I was faced with the problem of stimulating their thinking skills and the need to improve their basic computation skills. Whatever I designed must improve both skills. It may be easy to provide an environment for learning, but making that learning appear relevant to sixth grade students is no easy task. I did, however, come up with an exercise which improved their math language skills, stressed reasoning, computation, comparison, problem solving and evaluation. While tackling their weakest points: computation and money skills, I also appealed to their strongest point: their stomachs. My creation, dubbed "Pizza Math" was a definite success.

PROCEDURE

This assignment takes five days. It may run consecutively or you may wish to spread them apart. Step one involves getting the initial materials. Go to your local pizza joint (I used Pizza Hut) and ask for their take-home menu. They will love the free advertising. (I loved the free math material.)

DAY 1: Students were assigned to work in pairs. They were asked to use the

1A39 A

Pizza Hut menu to set up word problems. The question posed was, "How many different kinds of problems can you make up using the information on this menu?" At first, the students were frustrated by the lack of direction. But after "clearing" several problems with me... "Is this one the same as this one?...Well, what do you think?", they seemed stimulated to work on their own. Questions that were asked of me included, "Do we figure tax?", "How do we do that?", "Can I do this?". Most of my answers were, "Try it and see."

The students came up with an interesting variety of problems which I loosely classified into five types:

TYPE I: COMPARISON

The students wrote the following problems:

"What is the difference in price between a Pan and Thin medium pizza? (Or large and small, one ingredient and four ingredient, Super Supreme and Supreme?)

"What is the least expensive pizza to buy? How much does it cost?

"What is the most expensive pizza to buy? How much does it cost?

"Is it cheaper to buy a Super Supreme or a Deluxe Cheese with 9 toppings, assuming they are the same size, thickness and diameter? (How much more does it cost?)"

TYPE II: HOW MUCH MORE?

"A birthday party came with 9 kids and ordered 2 large thin-crispy pizzas with pepperoni, sausage, anchovies and mushrooms. Each had to pay $1 toward the pizza. How much more did the parents have to pay for the pizza?"

TYPE III: HOW MUCH WOULD X COST?

"Mrs. Bettsy Ross (honest, this is their problem) bought a large, thin and crispy deluxe cheese pizza to go. How much would the order cost if it were doubled?"

"Mrs. Presson bought a large pan pizza for $7.65. She also ordered 15 extra toppings. How much did she spend?"

TYPE IV: HOW MUCH WOULD EACH PAY?

"Two boys came in and ordered a medium pan pizza with Italian sausage. How much would each boy have to pay on the pizza?"

"Lori, Alison, and Beth went to Pizza Hut and bought one medium thin-crispy pizza with pepperoni. How much did each girl have to pay?"

TYPE V: HOW MUCH CHANGE?

"Mrs. Presson took her class of 28 kids to Pizza Hut. They each brought one dollar. They bought two Super Supreme Pan Pizzas. How much did Mrs. Presson's class have left to spend on drinks?"

"I ordered a small thin-crispy pizza with pepperoni and cheese. How much change did I receive from a $10 bill?"

TYPE VI...VII...VIII.....I DON'T KNOW WHAT TO CALL THESE...

The first one appeals to the child's ability to read the menu closely.

"Lori and Gina went to Pizza Hut and bought a small thin and crispy cheese pizza. They phoned the order in. How many minutes did they have to wait after they called?"

This one appeals to the child's awareness of the environment:

"Lori went to Pizza Hut and bought a small pan pizza with mushrooms and cheese and pepperoni. She also played two video games. How much did she spend?"

This one appeals to, well...

"A lady walks into Pizza Hut. They are charging 50¢ admission. They are showing movies. She orders a small Thin 'n Crispy pizza. How much did she pay?"

All these problems involved being able to read the menu, calculation (per cent, addition, subtraction, multiplication, division), greater than, less than, giving enough information to solve a problem. Writing clearly and computing accurately were important.

DAY II:

Students were assigned to work in a quartet. The two pairs exchanged problem sets and sat together. As they worked each others' problems, they were to consider these questions:

Is it clear? (What needs to be added to clarify the problem?)

What does it ask for?

Is this problem different from the others, or is it the same?

Is the computation correct?

The four students were then to make up a worksheet with their math problems and a separate answer sheet for grading purposes.

DAY III:

Our improved math sheets were sent to the other sixth grade class for their computation practice. Their answers were returned to my students who graded the papers from the answer keys that they had prepared. They then set up a per cent grading scale based on the number of problems on their worksheet.

DAY IV:

Students were to evaluate the cost of four cheese pizzas. Using a recipe, they were to list the ingredients needed and the amounts necessary to make four pizzas. They were to calculate the cost of the necessary ingredients and take a short trip to the corner quickshop for them.

DAY V: PIZZA PARTY

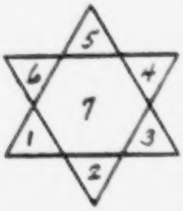
Using careful measuring to determine the amount of ingredients used per pizza and therefore, the actual cost of each pizza, the students were to make four cheese pizzas. After eating (which they all agreed was the best part) they were to compare the price of their four pizzas to the cost of four pizzas purchased at Pizza Hut. Noting the difference, students were asked if this amount represented true profit. Discussion brought out overhead expenses for Pizza Hut: employee's wages, utilities, napkins, advertising, boxes, etc.

This is obviously a popular unit from the students' point of view. But I considered it successful too, because it helped me accomplish much of what I set out to do. The students got computational practice and experience using money, but they got experience at real thinking and problem solving (to say nothing of tasty cheese pizza).

REARRANGING TWO TRIANGLES

Lois Ams

These two triangles are arranged so that they make 7 sections.



Show how two triangles can be arranged to make:

6 sections

5 sections

4 sections

3 sections.

WHAT'S IN 10?

Helen L. Miller

Materials: Each player has 10 interlocking Lego pieces or Unifix cubes in the same color.

Each player needs a sheet of paper and a pencil.

Method: Each player takes 10 pieces which must be the same color. After the pieces have been counted out the players each make columns of their 10 pieces. They then compare the respective heights of their columns to verify the fact that each has exactly 10 pieces.

Play: Each player must take his column apart and describe verbally what the result is. For example: one player may have two smaller columns of five pieces each; another player may have five very small columns of two pieces each; another may have three columns of three pieces and one piece. After the players become adept at dividing their respective columns of 10 in several different ways, they must record what the results are in some way (using written symbols of the result or by drawing a picture that will show the operation).

DIRECTIONS

Cathy L. Norton

Are you often upset and aggravated at the child who asks what he is supposed to do five seconds after you have finished giving directions? Do you have a right to be upset or does the real fault lie within your own poor method for relaying to the students how you want the task to be completed?

During the summer course, A. I. Weinzweig presented this problem to us: "Ask your students to tell what your instructions are." What better way is there to find out if the information in your head was transmitted to them? I tried this very process and found I had been assuming too much. Some bits of information I thought were already understood had been missed completely by my students. If this helped me to give directions more clearly, then why wouldn't the same process help in teaching a basic math process. What better way to find out if a child understood the idea than to ask him to "teach" it back to me in his own style?

"If I say one thing, but mean something else--what I mean is always correct!" (Or so Izzie says!)

ARITHMETIC ERRORS CAN TELL YOU MORE THAN YOU THINK THEY CAN

Eleanor Betz

Sometimes errors in arithmetic tell more than the level of the child's intellectual development. Sometimes a child's pattern of errors can give clues to physical problems which contribute to learning disabilities.

The following lists came from a handout developed by Cathie Karobey for use in a class on learning disabilities for teachers.

Visual Disorders in Arithmetic

1. The student may not be able to discriminate differences or similarities in size and shape of symbols.
2. He may exhibit discrimination difficulties such as writing 3 for 8 or 2 for 5.
3. He may not be able to learn sets or groupings.
4. The student may not be able to judge with accuracy spatial relationships that deal with distance and quantity.
5. He may have difficulty in learning to tell time.
6. The student may ruin materials, books, garments, etc. because he tries to force them into drawers or spaces that are too small. He may have difficulty in relating the size of an object to the appropriate container.
7. He may exhibit problems with the alignment and arrangement of numerals.
8. He may overpour his glass, have difficulty lining up buttons and put too much food on his fork.
9. He may exhibit a poor sense of direction, getting lost easily, not being able to find different places in the school or neighborhood.
10. He may have difficulty with historical sequence and with geography that deals with maps and globes.
11. He may have problems with right-left orientation and placement.

12. He may have difficulty with relating himself to an object in space and appear awkward and clumsy in his attempt to perform a physical task.

13. He may have difficulty understanding cardinal and ordinal placement.

14. He may exhibit reversals and write Ɛ for 3 or inversions and write 6 for 9.

15. He may not be able to write numerals.

Auditory Disorders in Arithmetic

1. He may not be able to retain an auditory sequence of numerals.

2. He may have difficulty with looking at a series of numerals while counting aloud.

3. He may exhibit difficulties with story problems which require him to assimilate and hold a great deal of information in his mind.

4. He may not be able to cope with rapid oral drills.

5. He may not be able to associate a numeral with its auditory referent.

DOING VISUALS

Helyn Phillips

This idea comes from Mr. Brandel, a syndicated cartoonist who does a cartoon called "Wordplay". Ask each child to choose a math vacabulary word (perhaps from a collection of such words that appears elsewhere in the classroom). Then ask the child to create a visual for that word--a way of writing it such that the way it is written gives a hint to its meaning. Here is an example.

```
A
N
G L E
```

TWELVE LOVES MOVE...

Catherine Berdonneau
Rose-Marie Dumas

In June 1982, Dr. Catherine Berdonneau (IREM, University of Paris Nord) conducted a Teachers' Center session on LOGO, a friendly interactive computer language which is especially usable with children. Here are some results of Dr. Berdonneau's LOGO work with children in Paris.

At the beginning of September 1981 ...

In a room at the I.R.E.M. (1) in Paris (France), a small group of pre-teen-agers (eleven years old about; they are entering 7th grade) comes every day to work with a computer for three to six hours. Such a situation is not that uncommon, since micro-computer clubs are rapidly increasing. What is rather unusual, is that the machine involved here runs the LOGO programming language.

The LOGO project was developed in the United States, during the late '60s, from the work of specialists in various disciplines (mathematics, computer science, psychology, physics, education, music...): LOGO thus denotes at the same time a theory of learning, a programming language, and a set of computer-controlled pedagogical devices.

The computer used during this session is a TT 3500 from General Turtle Corp. Ltd (Quebec) with LSI 11 and TT 2500 processors.

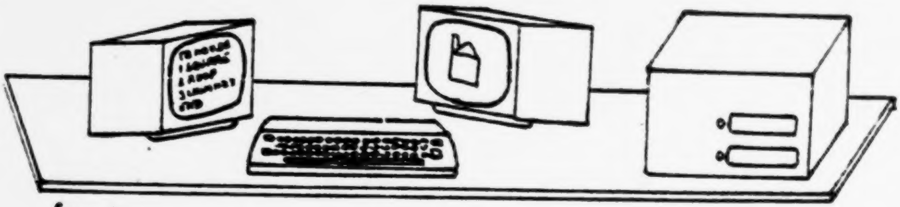


fig. 1

The keyboard enables them to give instructions to the computer. The alphanumeric display (also called text-display) shows the dialogue between user and machine, and the dynamic graphic display

(512 x 512 points) allows very neat drawings: a straight line is a straight line whatever the direction may be, it never looks like a "staircase" and it permits movement (with two primitives of the language: MOVE, straight translation, and SPIN, rotation). The disk-drives are used on the one hand to load the language and save the procedures, and on the other hand to record all the user-computer dialogue, i.e. commands typed on the keyboard and messages sent by the machine.

Having a very high-quality display on this computer led us, at least for a first step, to set the group towards graphics-oriented projects. In the center of the display is a little triangle, with a brighter point in the middle of one of its sides.

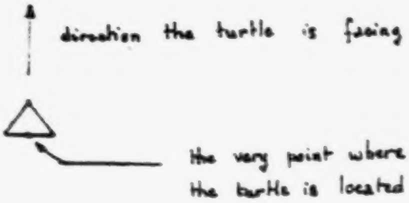

direction the turtle is facing
the very point where the turtle is located

fig. 2

It is referred to as a display "turtle", in comparison with "floor turtles": these are small computer-controlled robots(2), provided with wheels, a light, and a pen (which can be either in an up position, and then moving the turtle does not leave any trail, or in a down position, and then it can draw). Of course a display turtle has neither wheels nor light, but it still has a pen, and can as well be used for drawing.

The first commands for the turtle are very simple: FORWARD, BACK, RIGHT, LEFT, PENUP, PENDOWN (3)...

Before the beginning of this session, these children had never approached a computer but at the end of the previous school year they had spent one or two mathematics classes simulating the turtle and writing a few lists of commands in order to draw simple designs. They noticed at that time that you need to tell the turtle how many turtle steps it must walk forward or backward, and how many degrees it must rotate.

The children spent about 30 hours with the computer, and what they did is rather characteristic of what happens in a LOGO environment. The very first hours are given to groping, in order to get familiar with the machine -- how the letters are ordered on the keyboard, which keys play a particular role, i.e. space bar, rub-out or delete key, carriage return to send the message to the computer. Users soon get a very strong confidence, both in themselves and in the machine, due to the satisfaction of immediately seeing what happens and also because of the complete absence of such things as mistakes. When the machine does not "understand" something, it complains in a very polite and explicit way. For instance, if you type in

```
FORWARD100
```

which is analysed as a <u>single</u> word, unknown to the computer, you get the answer

```
I DON'T KNOW HOW TO FORWARD100(4)
```

or if you ask

```
RIGHT
```

it tells you

```
RIGHT NEEDS MORE INPUT(S)
```

("Oh yes, she does not know how much", the children immediately say.)

Similarly, if you forget to give a name to your procedure

```
TO
```

it gently warns you

```
INCOMPLETE STATEMENT
```

The children produced projects mainly in three domains: graphics, geometry, and plane-on-plane movements. We do insist that there is no program, either with the meaning this word has in computer science (it is <u>not</u> Computer Assisted Learning), or with the meaning "program" has for organization or curriculum. The children are completely free to determine which project they are going to work on -- a project is anything to be done with the computer -- and they carry it out with the most absolute autonomy.

GRAPHICS

A project is said to be graphics-oriented when the children's major aim is drawing, generally something figurative. Among the first projects (and this is a favorite theme also for younger children with whom we have been experimenting for the past four years): drawing a house.

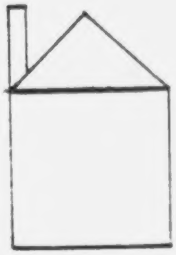


fig. 3

```
TO SQUARE
1 RIGHT 180
2 FORWARD 80
3 LEFT 90  FORWARD 80  LEFT 90
4 FORWARD 80  LEFT 90
5 FORWARD 80
END

TO ROOF
2  RIGHT 135  FORWARD 55
7  RIGHT 90  FORWARD 55
END
```

```
TO CHIMNEY
100  HOME
1000  FORWARD 45  RIGHT 90  FORWARD 10
1250  RIGHT 90  FORWARD 30
END

TO HOUSE
1  SQUARE
2  ROOF
3  CHIMNEY
END
```

This project will be returned to a few days later and transformed into a windmill. But instead of decomposing the final result into several elementary sub-procedures, as with the house, the children choose to undertake one single procedure. This will turn up some interesting bugs, bringing lots of laughter:

```
TO WINDMILL
1   FORWARD 50  RIGHT 90  FORWARD 10  RIGHT 90  FORWARD 50  LEFT 90
2   FORWARD 50  RIGHT 90  FORWARD 10  RIGHT 90  FORWARD 50  LEFT 90
3   FORWARD 50  RIGHT 90  FORWARD 10  RIGHT 90  FORWARD 50  LEFT 90
4   FORWARD 50  RIGHT 90  FORWARD 10  RIGHT 90  FORWARD 50  LEFT 90
5   PENUP  FORWARD 50
6   PENDOWN  FORWARD 10
7   RIGHT 45  FORWARD 77
8   RIGHT 135  FORWARD 77
9   RIGHT 45  FORWARD 110
10   RIGHT 90  FORWARD 40
11   RIGHT 90  FORWARD 30
12   LEFT 90  FORWARD 30
13   LEFT 90  FORWARD 30
14   PENUP  LEFT 90
15   FORWARD 30  PENDOWN
16   RIGHT 180  FORWARD 70
17   RIGHT 90  FORWARD 90
END
```

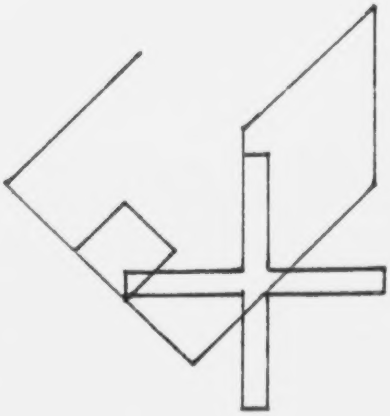


fig. 4

which gets changed into

```
TO  WINDMILL2
1  FORWARD 50  RIGHT 90  FORWARD 10  RIGHT 90  FORWARD 50  LEFT 90
2  FORWARD 50  RIGHT 90  FORWARD 10  RIGHT 90  FORWARD 50  LEFT 90
3  FORWARD 50  RIGHT 90  FORWARD 10  RIGHT 90  FORWARD 50  LEFT 90
4  FORWARD 50  RIGHT 90  FORWARD 10  RIGHT 90  FORWARD 50  LEFT 90
```

```
5  PENUP  LEFT 90
6  FORWARD 50  RIGHT 90
7  PENDOWN  FORWARD 10
8  RIGHT 45  FORWARD 77
9  RIGHT 90  FORWARD 77
10  RIGHT 45  FORWARD 110
11  RIGHT 90  FORWARD 30
12  LEFT 90  FORWARD 30
13  LEFT 90  FORWARD 30
14  PENUP  LEFT 90
15  FORWARD 30  PENDOWN
16  RIGHT 180  FORWARD 70
17  RIGHT 90  FORWARD 90
END
```

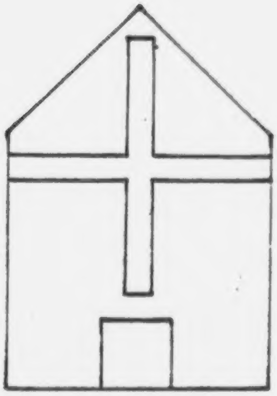


fig. 5

Of course, one can't resist making the sails whirl around! Another graphics-oriented project: to draw, on the graphic display, letters and digits.

```
TO  J
1  LEFT 90  PENUP
2  FORWARD 190  PENDOWN
3  RIGHT 90 BACK 15
4  RIGHT 90  FORWARD 20
5  LEFT 90  FORWARD 100
6  LEFT 90  FORWARD 20
7  PENUP  BACK 20
8  PENDOWN BACK 20
END
```

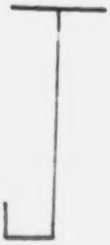


fig. 6

```
TO  E
1  PENUP  BACK 20
2  PENDOWN BACK 40
3  LEFT 90  FORWARD 30
4  RIGHT 90  FORWARD 40
5  RIGHT 90  PENUP
6  FORWARD 30  PENDOWN
7  BACK 60  RIGHT 90
8  FORWARD 40
END
```

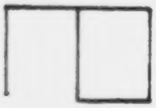


fig. 7 (as displayed if you type in E after clearing the screen)

```
TO  A
1  PENUP  FORWARD 20
2  PENDOWN  FORWARD 40
3  LEFT 90  FORWARD 30
4  LEFT 90  FORWARD 40
5  LEFT 90  FORWARD 30
6  PENUP  BACK 60
7  Left 90  FORWARD 40
8  RIGHT 90  FORWARD 30
9  PENUP  FORWARD 30
10  PENDOWN  LEFT 90
11  LEFT 90  PENUP
12  FORWARD 30  PENDOWN
13  FORWARD 30  LEFT 90
14  FORWARD 40
END
```

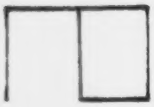
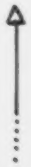


fig. 8 (as displayed if you type A after clearin the screen)

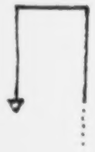
(Notice that lines 6 to 12 induce a long walk which could have been substantially shortened).

(a)

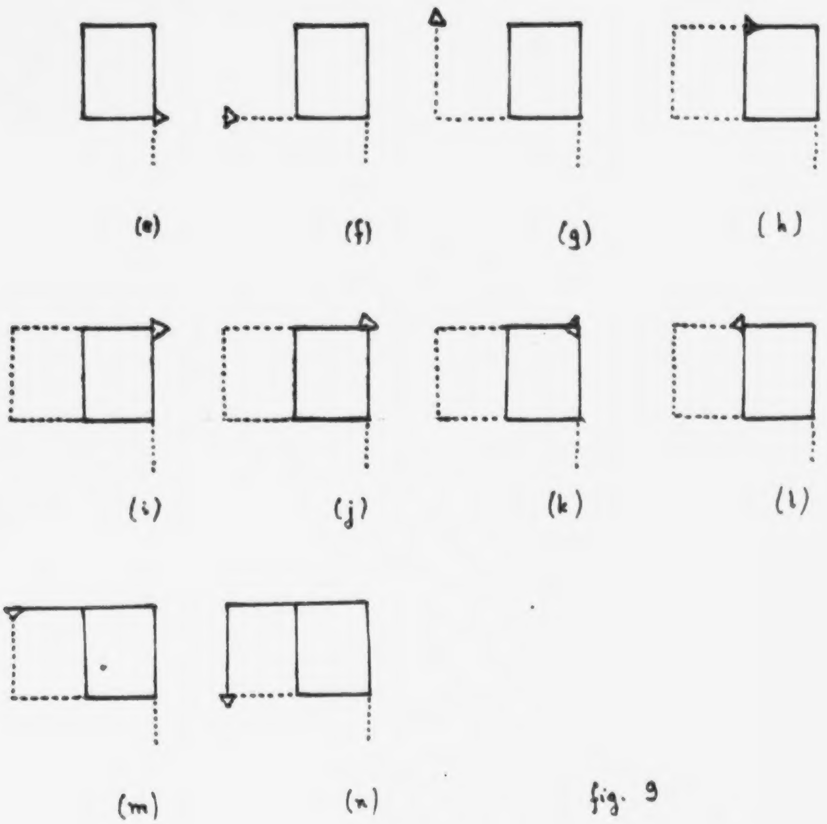


(b)

(c)



(d)


(e) (f) (g) (h)

(i) (j) (k) (l)

(m) (n)

fig. 9

```
TO N
1  PENUP  FORWARD 20
2  PENDOWN  LEFT 90
3  FORWARD 60  RIGHT 135
4  FORWARD 84  LEFT 135
5  FORWARD 60
END
```

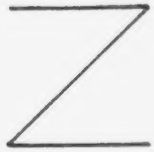


fig. 10

The following steps are observed

J E

then

J E A

but

J E A N

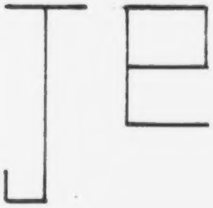


fig. 11 a

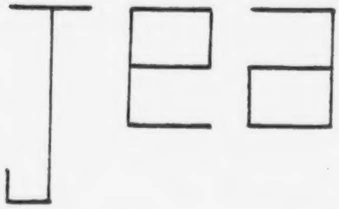


fig. 11 b

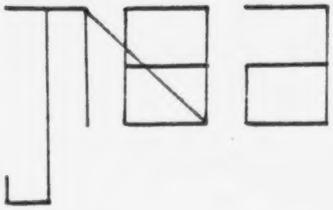


fig. 11 c

Hence the modification, first in "driving mode" (5), after J E A

```
    PENUP   BACK 40   LEFT 90
    FORWARD 60   PENDOWN   LEFT 90               -----------
    PENUP   FORWARD 20   PENDOWN   LEFT 90         fig. 12
    FORWARD 60   RIGHT 135                       -----------
    FORWARD 84   LEFT 135
    FORWARD 60
```

which displays a satisfactory result.

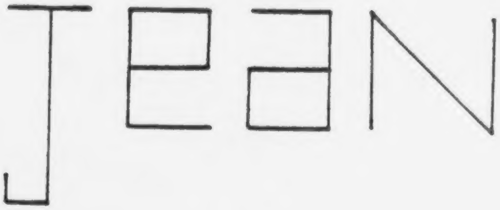


fig. 12 and fig. 13

A new attempt, still in driving mode,

```
    RIGHT 180   PENUP   FORWARD 40   FORWARD 20
    RIGHT 90   FORWARD 60   RIGHT 180
    FORWARD 60   RIGHT 135   FORWARD 84
    LEFT 135   FORWARD 60   HIDETURTLE
```

is then written as a procedure:

```
TO EN
1  RIGHT 180   PENUP FORWARD 60   RIGHT 90   FORWARD 60   RIGHT 180
 PENDOWN   FORWARD 60   RIGHT 135   FORWARD 84   LEFT 135   FORWARD 60
END
```

And then, a super-procedure is built:

```
TO  SUCCESS
1  J
2  E
3  A
4  EN
END
```

with its evocative name !

Let us stress that children are deeply focusing on a very precise project, and that their strategy only aims at <u>this</u> specific project: in this particular case, the letters A, E, J, N are drawn only in order to write the name JEAN. This explains why they are not looking for a method allowing the drawing of any letter, and why these mini-procedures can't be used for the names JANE or JEANNE.

The same kind of focus is to be found with procedures dealing with digits: each child chooses a digit, and systematically clears the screen before he starts. Thus, when they first try the procedure

```
TO  DIGIT
1  ZERO
2  ONE
3  TWO
END
```

all gets mixed up!

However, an attempt toward globalisation is noticed when one child pointed out that some digits can be made from others, for instance 8 from 3 and 1 ; he also observed that some digits can be drawn by rotating some others, for instance 6 and 9 . Nevertheless, he didn't infer that one procedure can be used as part of the other.

A procedure called EXA(6), which was written during the previous school year by 5th-graders, happened to be at their disposal, and the children made various uses of it:

a tunnel

```
TO  EXAGON
1  EXA 10
2  EXA 20
3  EXA 30
4  EXA 40
5  EXA 50
6  EXA 60
7  EXA 70
8  EXA 80
9  EXA 90
10  EXA 100
END
```

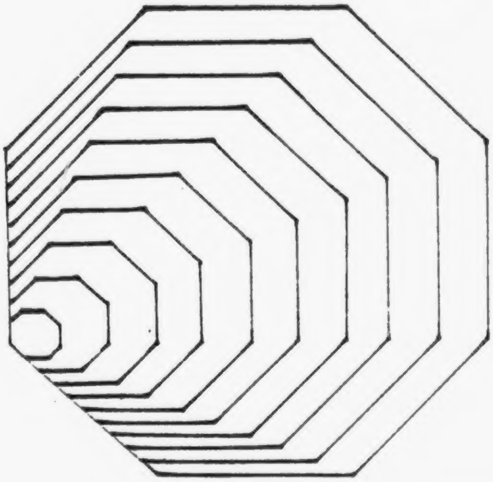


fig. 14

a "fly" procedure

```
TO  FLY
1  PENUP  EXAGON
END
```

(the reader is kindly requested to imagine what is drawn !!!)

a flower

```
TO  DAVID
1  EXAGON
2  RIGHT 90
3  EXAGON
4  RIGHT 90
5  EXAGON
6  RIGHT 90
7  EXAGON
8  RIGHT 90
END
```

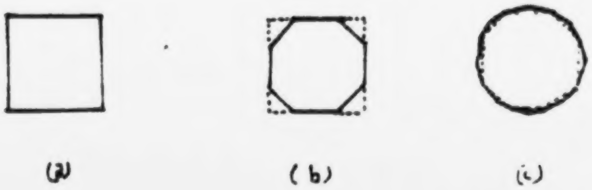
GEOMETRIC PROJECTS

The fascination created by circles is one of the constant features of all our experiments. The main problem, since the machine does not know CIRCLE nor ROUND -- which always surprises the children -- is to find a method to make the turtle draw a circle. This is far from immediate. Indeed, the usual definition of a circle as a set of all points in a plane at a fixed distance from a given point in the plane is absolutely useless for a turtle. The turtle only can walk FORWARD or BACK, or turn RIGHT or LEFT. It proves generally quite helpful to suggest that the child himself play the turtle and try to explain how he walks on a circle. So we somehow or other draw a circle on the floor with a string and a piece of chalk. Unfortunately, the "gardener's cord" reinforces the idea of center and radius.

The first suggestion given by the children was to put the turtle at the center, draw four perpendicular radii, and then "just join the end of these radii with arcs of circles". Obviously this should a priori be a good way to make the problem simpler, but drawing arcs of circles is no easier than drawing a whole circle.

Fortunately, it was lunch time, and children had a well deserved pause. Then, with new forces, they came back to the idea of drawing a circle. Perhaps this break for meal and rest brought a new vision on the subject, since a new approach was suggested by that same pupil, now completely ignoring the school definition of the figure: "A square has too sharp corners. In order to make it look more round, the corners must be cut off. But it is still not round enough, so, on the sides, 'little roofs' must be put".

fig 15



(This leads to an approximation with a 16 sided polygon, which visually is quite satisfactory.)

Simultaneously, two other children worked on a project to draw a round figure. Here too, they soon got convinced that they must have the turtle walk FORWARD and rotate to the RIGHT a certain number of times. But how much? A few tests were made in driving mode. A first suggestion was to diminish progressively the input value given to FORWARD: 19, then 18, 17, 16, 15...: But then came a flash of insight: "Two radical treatments have to be used at the same time, balancing a smaller FORWARD with a smaller RIGHT." The procedure was named TRUTH, since it draws a <u>true</u> circle:

```
TO  TRUTH
1  RIGHT 10 FORWARD 10  RIGHT 10  FORWARD 10  RIGHT 10  FORWARD 10
  RIGHT 10  FORWARD 10  RIGHT 10  FORWARD 10  RIGHT 10  FORWARD 10
END
```

which draws a sixth of a circle. Repeating it six times, the long-awaited circle appeared. It was named SUN.

The TRUTH procedure gave birth to new projects: how to draw an oval, and a spiral. The oval was approached through this first step:

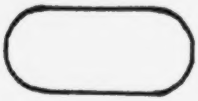


fig. 16

Then the result was improved by replacing the two straight segments by arcs of circles. For that, they expressed the need for a procedure to draw "rounds with a variable radius":

```
TO  TRUE  :D
1  RIGHT :D  FORWARD 10  RIGHT  :D  FORWARD 10  RIGHT :D  FORWARD 10
2  RIGHT :D  FORWARD 10  RIGHT :D  FORWARD 10  RIGHT :D  FORWARD 10
END
```

But the oval does not close. They would therefore modify the procedure, now having a parameter for FORWARD and leaving RIGHT with a fixed input of 5.

The snail requires a very long sequence of commands, and thus brings the students to analyse the procedure they are thinking of. Similarities between the successive steps are brought to light, hence the use of a parameter (FD is the short form accepted by the computer for FORWARD, and RT for RIGHT):

```
FD :C  RT 10  FD :C RT 10  FD :C RT 10  FD :C  RT 10
```

and then they try to express a rule which binds the variations: the machine must do this same line again with a smaller value for :C. This leads to a recursive procedure. But since the children knew that the machine must be told everything,(7) they wondered how they could tell it to stop. Hence this recursive parametered procedure with a stop rule:

```
TO  SNAIL3 :C
1  FD :C  RT 10  FD :C  RT 10  FD :C  RT 10  FD :C  RT 10
2  IF  :C > 1  SNAIL3  :C - 1
END
```

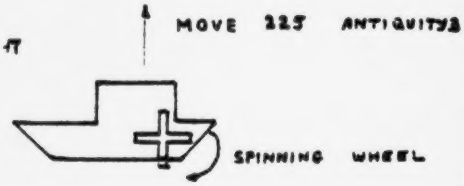
USING MOVEMENT PRIMITIVES

Movement fascinates the pupils. It brings some spectacular bugs, especially when translation and rotation are combined together. Determining which is the appropriate translation is not obvious. The primitive MOVE (which requires an input, the translation speed) produces a translation in the direction the turtle is currently facing. Thereafter, the turtle being HOME at the center of the screen looking topwards:

MOVE 225 ANTIQUITY3

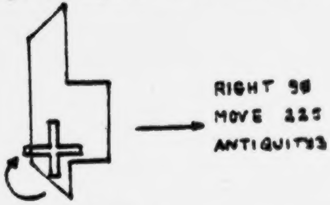
turns the boat called ANTIQUITY3 into a ... helicopter..

fig. 17



It is brought back to earth -- or sea -- by first rotating the turtle rightwards a quarter turn:(8)

fig. 18



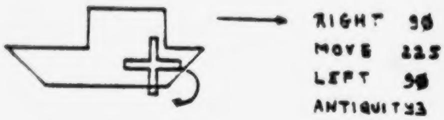
RIGHT 90 MOVE 225 ANTIQUITY3

But is this a boat, or a sea-horse?

The third attempt proves correct:

RIGHT 90 MOVE 225 LEFT 90 ANTIQUITY3

fig. 19



Adults have to learn to refrain from interfering when children are grappling with a problem, since solutions proposed by adults and children generally are quite different.

For instance, after MOVing an EXAGON, the pupils suggested as a new project to draw a second figure which would remain stationary. For an adult, a standard idea consists in balancing the action MOVE 100 with MOVE -100. Indeed, at the end of grade 6 students do have some knowledge about integers but they still are not really familiar with them. And they came to as efficient a solution, turning the turtle face back with RIGHT 180 and then introducing a second MOVE 100: the desired effect is obtained, and it is so much more ... natural!

On the last day of the session, this feature allowing moving pictures on the screen was explored systematically. Children first built a procedure drawing a heart

```
TO LOVE
1  FD 10  RT 10  FD 10  RT 10  FD 10  RT 10  FD 10  RT 10  FD 10  RT 10
2  FD 10  RT 10  FD 10  RT 10  FD 10  RT 10  FD 10  RT 10  FD 10  RT 10
3  FD 10  RT 10  FD 10  RT 10  FD 10  RT 10  FD 10  RT 10  FD 10  RT 10
4  RT 180
5  RT 10  RT 10  FD 10  RT 10  FD 10  RT 10  FD 10  RT 10  FD 10  RT 10
6  FD 10  RT 10  FD 10  RT 10  FD 10  RT 10  FD 10  RT 10  FD 10  RT 10
7  FD 10  RT 10  FD 10  RT 10  FD 10  RT 10  FD 10  RT 10  FD 10  RT 10
8  FD 10  RT 10  FD 10  RT 10  FD 10  RT 10  FD 10  RT 10  FD 10  RT 10
9  FD 10  RT 10  FD 10  RT 10  FD 10
10  FD 50
11  FD 80
12  RT 90  FD 130
13  FD 10  RT 10  FD 10  RT 10  FD 10
14  FD 10  RT 10  FD 10  RT 10  FD 10  RT 10  FD 10  RT 10  FD 10  RT 10
END
```

then they tried

```
     MOVE 10  SPIN 10  LOVE
```

just to see what it looked like; then they repeated the same command a second time

```
     MOVE 10  SPIN 10  LOVE
     MOVE 10  SPIN 10  LOVE
```

up to twelve times!

The results are fascinating. Some were given special names:

- the subway at rush hour (completely scribbled drawing)
- a deck of cards being fanned out
- roses (various types)

A CONCLUSION?

There is no conclusion. The children expressed very strongly their will to have a similar session during the next holidays. They were obviously enthusiastic and already had lots of projects for the future session. All those who observed them working gathered a large amount of information, which is still being classified, analysed, and compared with experiments in a classroom context. Evidently the activity was very rich in terms of both the creativity which was developed and the number of topics (mainly geometric) children dealt with (on which they acquired empirical knowledge, preparing for a more theoretical approach in upper grades). And what about computers? Did they get a few ideas on this too? Yes: programs, parameters, recursion, incrementing and decrementing, testing... all this being manipulated without formal teaching. And above all, a complete demystification of this machine "which only does what you expressly tell it to do!"

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R.C.P. LOGO	Pratique active de l'informatique par l'enfant Recherches Pedagogiques n° 111 (I.N.R.P.-S.E.V.P.E.N.), 1981.
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Notes

(1) I.R.E.M.: Institute for Research on Mathematics Education

(2) A half glob protects the various inner parts of the robot, and makes it look a little like a turtle. The most common turtles are connected to the computer by means of a wire. A new breed, presently grown in France, is operated by remote control. It is called a ladybird.

(3) The programming language used by the children is a French version of LOGO, using almost only French words as commands (the only exceptions are DEBUG, OUTPUT and SPIN). However, for easier

reading, all the primitives quoted in this paper have been restored to their English names, and the procedure names also translated.

(4) Other versions would return:

```
TELL ME HOW TO FORWARD100
```

or

```
YOU DIDN'T TELL ME HOW TO FORWARD100
```

(5) In driving mode, commands get executed with every "carriage return", and the computer does not keep in memory the commands it was given.

In procedure mode, or programming mode, the execution is delayed and takes place only when one types in the procedure name. The procedure name can be typed in as many times as one likes in order to have the action repeated for instance.

(6) The children are free to choose any name for their procedures. When their spelling does not agree with the spelling commonly used, and/or when the meaning they assume for the word is not the usual one, they are asked to check with a dictionary. Nevertheless they remain the only ones to decide what to do, to follow the tradition or keep their own wording.

(7) Even what is "obvious"! Thus, they were astonished when they typed in

```
PRODUCT 140 5
```

to get the answer

```
WHAT SHOULD I DO WITH 700 ?
```

since this PRINT, indispensable for the machine, seemed to them perfectly clear ...

(8) Rightward, not leftward as could seem logical, since the "wheel" moves wrong way round, and therefore takes the boat to that direction!

GROWING UP TAKES TIME

Helen L. Miller

Orson Wells says that the process of aging fine wines cannot be hurried. "No wine before its time", he tells us. David Elkind, professor and chairman of the Eliot-Pearson Department of Child Study, Tufts University, says that childhood must not be hurried--"Growing up takes time!"

Nature has wisely provided a specific amount of time for the fertilized egg to grow and to develop in the mother's womb, a process which dare not be hurried. Nature has allotted the human being a specific amount of time to grow and to mature known as childhood, a process which also dare not be hurried.

The growth of the fetus takes nine months. The growth of a child requires eighteen or nineteen years. We don't accelerate the first nine months before birth, but we tend to rush kids through childhood.

Rousseau, Dewey, Gesell and Piaget have enabled us to understand that a child is not a small adult. In our rush to prepare children for the "hard world out there", we too often face children with issues that they cannot understand or intellectually process. It is far more appropriate to provide children with experiences which developmentally fit their level of understanding in order to prepare them for the world in which they live.

It is often assumed that children know much more than they actually do, because they have a great deal more verbal proficiency than we had as children. Although children are now exposed, both visually and verbally, to far more advanced ideas than were children ten or fifteen years ago, the children of today don't have any more understanding of those ideas than children have ever had. QUANTITY OF INFORMATION DOES NOT INSURE QUALITY OF UNDERSTANDING.

One of the most obvious causes of stress for children is TV. All facets of life are explicitly depicted on TV and TV may be viewed by children for many hours each day. Children must now, not only share adult worries, but be exposed to adult drama for most of their waking hours. TV programs reflect a changing society in a manner to which the child cannot relate.

An adult is able to see a drama on TV, at the movies, or on the stage, and is capable of understanding that a particular presentation simply reflects one author's point of view, not the world as it actually exists. A child deluged with ten to twelve hours of TV is not able to make this distinction. A child cannot differentiate between what he sees on a screen and what is the real world. For a young child, a perceptual learner, what he sees is what is real.

Schools, too, are guilty of hurrying children and causing stress. In the great race to prove how indispensible public school education is, administrators have insisted that children learn to read at an earlier and earlier age. Materials and skills are pushed down, level by level, and competency is expected in areas that children are not developmentally ready to achieve. First grade children are rotated from classroom to classroom when they need the security of one familiar environment and of one teacher. Children are also expected to begin "formal education" long before they are ready.

Dr. Elkind stated that the first priority of education should be to teach children to be people. Between the ages of three and six years of age, children need the opportunity to explore materials, to fantasize through dramatic play, and to investigate art activities. A young child does not need abstract numerical or alphabetical symbols in order to learn about his environment.

It is imperative that young children have less formal, directed activities because children learn by abstracting from their individual experiences. "We don't teach a child to use materials effectively." According to Dr. Elkind, "Motoric experiences are vital to a child's development." Children must have horizontal enrichment and not be propelled vertically into areas which they are not yet ready to understand. The task a child is required to perform must be commensurate with his developmental level of understanding.

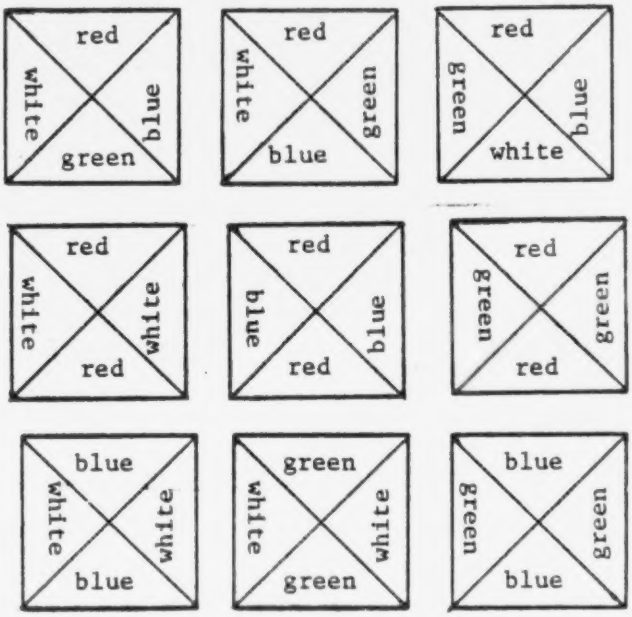
Dr. Elkind forecasts many changes in society as our culture moves from one which was industrial into a society which is service oriented, a post-industrial age. With this new era adults must acknowledge the fact that childhood is a unique time in a human being's existence. It is a time when children process vast amounts of information at their own speed. Children need adults to lead them and, most importantly, to be responsive to their feelings.

For educators who want children to have the time they need to grow and mature, Dr. Elkind said, "Everyone must light one little candle." Each of us, in our own small corner, can help to give children the time they require to learn, to process that learning, and to apply what they have understood in the post-industrial age in which we now live. Certainly, our children are worth far more than all the vineyards in the world.

MATCH 'EM UP!

Beverly Ostendorf

Copy, color and cut out these nine squares. Now place them in a 3 X 3 arrangement such that where any two squares touch, the same colors touch.


red
white
blue
green
red
white
green
blue
red
green
blue
white
red
white
white
red
red
blue
blue
red
red
green
green
red
blue
white
white
blue
green
white
white
green
blue
green
green
blue

TO EDUCATE MEANS...

Annemarie Garcia

I would like to share with you a statement that Izzie Weinzweig repeated frequently during the first few days of the summer course. His statement was something like this:

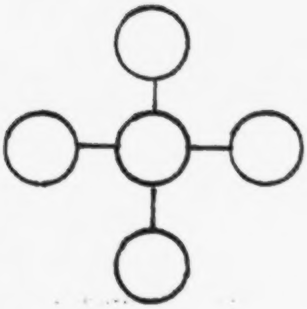
"To educate means to lead out not to shove in."

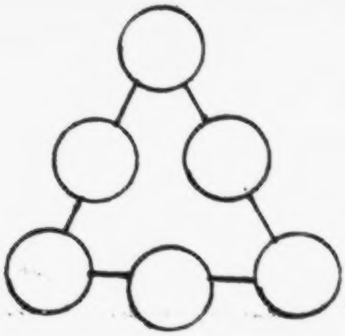
This statement is probably the most valuable idea I took from the course. Subconsciously, this statement will always be with me. Too often teachers (including me) do a lot of shoving of knowledge into our students, where more often the students need to be guided in their thinking. They need to learn how to solve problems, especially in math, by looking for patterns to the solutions which will guide them to even more solutions or to a conclusion to why there are not any more solutions.

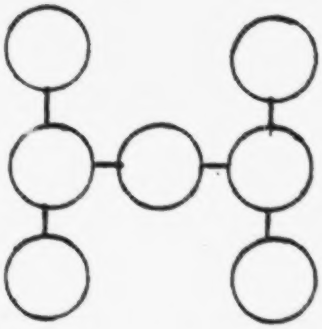
Students need to be given more problems that have many solutions. Is it not the case that many of the problems we face in our lives have more than one solution and all solutions need to be examined and analyzed?

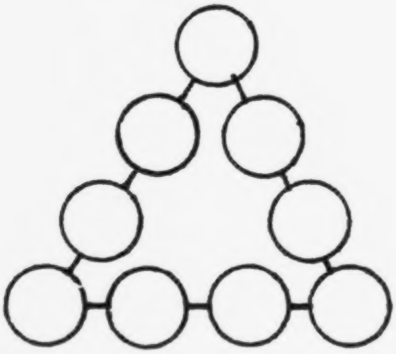
Here is a problem that Izzie gave us during the summer course. I put the directions on a bulletin board and left room for students to post their solutions.

MAKE ALL VERTICAL, DIAGONAL, AND HORIZONTAL SUMS EQUAL









How many solutions can you find?

What kinds of conclusions can you make to prove that you have all the solutions to a given design?

Can you make a design of your own?

Can you make a design that has no solutions? Why?

NUMBER NAMES

Helyn Phillips

Give each student a sheet of 8½ X 11 paper. Have them fold the paper in half and then fold the half in half so that when the paper is opened, there will be four sections on each side of the paper.

Give each student a number (any number chosen at random) and ask him/her to write eight different names for that number--one in each folded section.

Example--this child was given 4 as his number:

4	four
2 + 2	5 - 1

quad- rant	quar- tet
3 + 1	8 - 4

PROFESSIONAL SKILLS

David Lingard

Here is a list of professional skills devised by David Lingard and presented at the annual meeting of the Illinois Council of Teachers of Mathematics in November 1982. What appears here are "talking notes" which David used in his presentation. A lengthier discussion will follow in a later SEEDBED.

The ability to:

1. Get to the level of the student and see things from his/her point of view.
2. Diagnose and empathize with students' difficulties.
3. Handle students' fear and anxiety about mathematics with sensitivity.
4. Increase students' confidence.
5. Explain ideas lucidly; use a variety of approaches.
6. Listen to the children.
7. Present mathematics in a context, making heavy use of applications.
8. Handle class discussions with respect and concern.
9. Develop a respect for the students' own mathematics.
10. Show the relationship between different topics to bring out the unifying structure of mathematics.
11. Use appropriate language.
12. Make the work interesting and enjoyable.
13. Produce suitable material for the classroom.
14. ....
15. ?

AND

Accept that learning how to teach is a lifetime occupation.

SHOPPING SPREE

Linda Abell

This activity can be used to help students realize how basic math skills are used in real life situations. I often use it before Thanksgiving (preparing a feast) or at Christmas time (shopping for gifts).

Materials: Several newspapers or grocery store flyer and mail order catalogs.

Directions: Students are given a shopping task.

Sample: Using this J. C. Penney catalog, select one gift for each member of a family of four (father, mother, boy-age 10, baby sister). You have $40 to spend. Don't go over this amount. Spend your money wisely. Make the gift appropriate.

Sample: Using grocery store flyers, you are to plan a special meal for your family. (Remember to plan a balanced meal by using the four basic food groups.) You have $15 to spend on this meal.

Winner: Each group is given the directions and materials to work out their best solution to the problem. The winning group will be the group who spent an amount closest to the target amount and used good consumer sense!

A MAJOR BARRIER TO CHANGING METHODS OF TEACHING COMPUTATION

Ed Labinowicz

Readers may be acquainted with Ed Labinowicz's book, The Piaget Primer *(Addison Wesley, 1980). If you're not, you should be. Ed asked a number of Teachers' Center participants to read and react to the manuscript for his next book, soon to be published by Addison Wesley. For the past several months we have been engaged in the task. The book is one of the best treatments of children's thinking we have seen. Here, with Ed's permission, is a section from his draft manuscript dealing with standardized testing.*

Despite repeated indictments of the "Back to basics" methods by mathematics educators and local attempts to initiate innovation, the teaching of computation as isolated skills still dominates classroom practice. A major barrier to the implementation of innovative teaching is the measuring stick applied to most programs--the standardized achievement test.

Standardized achievement tests rate and rank children according to their competence on a narrow range of tasks that can be scored readily. At the same time that standardized achievement tests are unable to determine the quality of children's thinking underlying their computational responses, they fail to sample adequately the different areas of mathematics beyond computation. As a result, these tests are at best only a crude estimate of children's mathematical competence. The fact is that they rarely provide teachers with new information. Teachers, by and large, know their children much more fully than standardized tests. Moreover, they underestimate the abilities of children because of their paper-and-pencil format. Although several learning modes may have been used in learning computational algorithms in the classroom, the standardized achievement tests keep to a single mode.

Children who are working at place value concepts with physical materials and oral discussion may be progressing nicely, yet the paper-and-pencil tests do not attend to this progress. Further, they are thrust into a situation in which they cannot succeed for the purpose of being ranked and rated according to their worth. Rather than useful information to the teacher to support future learning, such tests often merely provide children with frustration and failure. The tests give credit only for computational skills, thereby making little distinction between children who have mastered computational skills in the context of arithmetic meanings and those who have only mastered the isolated skills. Thus, the abilities of the latter group are grossly mismeasured by standardized achievement tests. In short, these test results communicate little practical information to the teacher. Most teachers know much more than the high-cost computer printout of results.

In spite of their failure to provide practical diagnostic information for the teacher, the dangers of mislabelling children, the cost in learning time lost during extended periods of testing and the cost in terms of damaged classroom learning atmosphere, not to say anything of the cost of the materials themselves, standardized achievement tests proliferate in the schools. They serve the American concern for a quantitative measuring stick that, despite gauging only the veneer of school learning, satisfies a political need. The test results allow administrators to compare school districts and schools, principals to compare classrooms and teachers, teachers to compare children, and parents to boast about their child's 80th percentile ranking on national norms. This focus on test score comparisons puts pressure on teachers to look better on the next year's test results. As a result, standardized achievement tests exert a major influence, not only on what is being taught, but also how it is taught. Concerns for maximizing children's learning and looking good on the test results are often not compatible. Occasionally, a delay in symbolic emphasis coupled with conceptual development with materials in the first half of the year can prepare the children for understanding the paper-and-pencil format of workbooks and achievement tests. However, since numerical concepts evolve gradually and teaching from "concrete to abstract" is a long-range goal, the pacing provided by publishers' textbooks and achievement tests is unreasonable for many if not most children. Under such pressures, most teachers resort to traditional teaching methods encouraging superficial learning that shows up well on the tests. Since innovative programs based on concerns for developmental learning are unable to show immediate gains on these tests, but have the potential of doing so over a longer period, these programs are quickly phased out. Many administrators are more concerned with looking good in the community with apparent quick gains than taking a risk fostering potentially valuable innovations in teaching meaningful mathematics. By discouraging innovation, standardized achievement tests have tended to standardize the curriculum across the country (DeRivera, 197_; Project Torque, 197_). Nothing short of a moratorium on standardized achievement testing will free educators to listen to children and expand their perspective of teaching and learning.

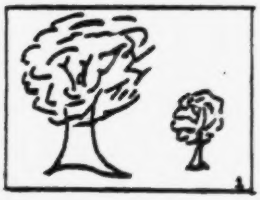
THE ELUSIVE WORD PROBLEM

Diana Fuehs

Most junior high students have a mental block against word problems. I can't decide if this is due to the attitude (negative for the most part) of their previous teachers or the students' difficulties with reading.

Regardless of the cause, it's a real situation that has to be dealt with. Using simple pictorial problems has helped me.

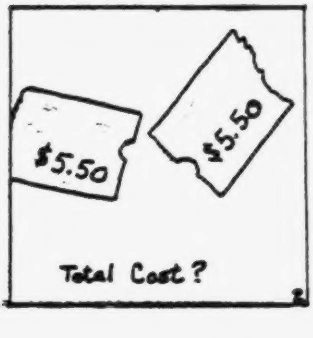
Pictures may be taken from many sources (magazines, papers, etc.). The students are asked to tell a story about the picture. Questions based on the story can then be asked.



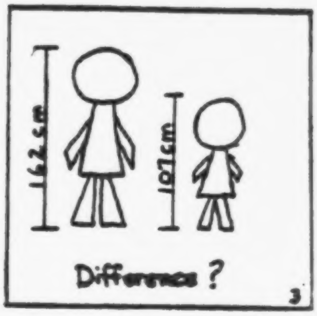
For example: "In John's yard there are two trees. They are different heights." This is the story one of the students told about this picture. (Fig. 1)

A question might then be asked: "What is the difference between the heights of these two trees?"

The student comes to realize that this question can't be answered until the height of each tree is known. Then he needs to consider how this information can be used to answer the question. Other questions can be asked as well.



The next step is to have pictures like Fig. 2 and 3. These involve asking a question about a situation in which all pertinent information has been supplied. Gradually the transition from less picture to more words must be achieved. This

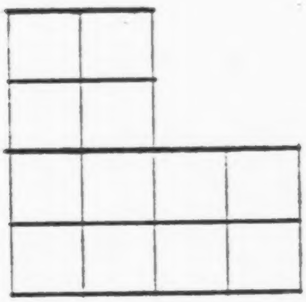


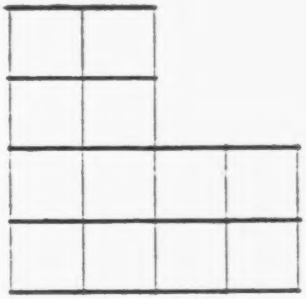
method of presentation also allows each student to develop the ability to imagine (or mentally picture) the problem.

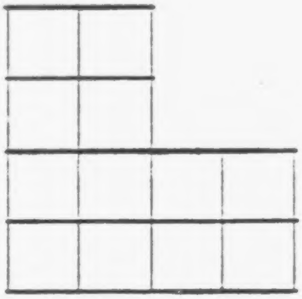
DIVIDING IN ANOTHER WAY

Deborah Cunningham

Divide one of the figures into two equal identical parts. Then try to divide another one of the figures into three equal identical parts. How about 4?







NO NINES = 100%

Mary Ann Tieman

Here is a yarn I tell my fifth graders every year and it never fails to make a hit.

First, I write on the board in a column: 1 x 9 = __, 2 x 9 = __, . . ., 9 x 9 = __. Admittedly, at this point, I don't have everyone's attention or interest, and I'm not much of a "hit."

Then I tell the story:

A teacher gave this test on the 9's facts. Tommy just stared at his paper, wagged his head from side to side, and became quite frustrated. He looked at the first one, 1 x 9 = __, concluded that he wasn't sure whether he knew the answer or not, so decided to leave it blank.

He went on to the second one, 2 x 9 = __, said to himself, "That's one I don't know," and proceeded to place a 1 in the answer space next to the example.

He continued on to the next, 3 x 9 = __, and readily agreed with himself, "That's 2 I don't know," and proceeded to place a 2 in the answer space.

He continued in this manner, deciding each time that he didn't know the answer for any of the rest of them either and proceeded to number each one missed as he went along.

By the time he got to 9 x 9 = __, -- that was 8 he didn't know. At this point Tommy was dissatisfied with his count of 8 and decided to check it again. This time he'd start at the bottom. "That's 1 I don't know." The 1 went to the right of the 8. "That's 2 I don't know." The 2 went next to the 7. "That's 3 . . . ."

When he finally got back to the first one which he had skipped earlier, 1 x 9 = __, he was so frustrated he couldn't think of that answer either. He decided that was 9 he didn't know and so marked down the 9, and then turned in his paper.

The numbers he had written in the blanks were the correct answers!

At the end of my story, children invariably ask: "How did you do that?" "Why did that work?" "Does it work with other numbers?" "What about 10 x 9 and 11 x 9?"

Discussion that follows usually produces the following results:

1. Children see that the sum of the digits for each answer is 9.
2. They note that the tens digit is one less than the N in the N x 9 question.
3. They are ready to explore the 9's further including 11 x 9 = 99 (casting out 9's) and divisibility of a number by 9.
4. They are ready to look for patterns in multiples of other numbers.

Before the class session is over, I usually get several requests to tell the story again.

DIGITS IN A STADIUM

Jeanne Edgar

Starting with 1, it takes 852 digits to number consecutively the seats in a section of a stadium. How many seats are in the section?

Next, you are to assume that you are the purchasing agent for the stadium. How many of each digit must be ordered for this section?

(This problem is adapted from Macmillan Mathematics.)

CONSTRUCTIVIST EDUCATION: A DIRECTION FOR THE TWENTY-FIRST CENTURY

Constance Kamii

I am very honored to have been asked by Patsy Chronis to give this lecture in celebration of the tenth anniversary of Circle Children's Center.* Maureen Ellis was the first teacher when the Center opened in 1972, and I joined her soon afterwards in her efforts to provide not only quality day care for young children but also a good educational program. Maureen quickly became a constructivist teacher, and when Patsy became the Director, she began to provide the solid leadership that resulted in the kind of school we are proud to have today. My close contact with the Center ended about three years ago, as my research moved on to the first grade. But Patsy and Maureen continue to stand staunchly for constructivist education, and I am pleased to maintain my relationship with the Center as a consultant.

I would like to divide my presentation into two parts. First, I would like to clarify what I mean by constructivist education. In the second part, I would like to discuss why I think constructivist education is a direction for the twenty-first century.

Constructivist Education

Constructivist education is based on a theory that explains learning as a process of construction from within the individual, rather than one of internalization or absorption from the environment. For centuries, educators have believed that if we want children to know something, all we have to do is provide instruction. If children did not learn, educators blamed the method or teacher and looked for more effective ways of getting children to internalize the material. The general practice today is still this approach of trying to stuff knowledge into children's heads.

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*The assistance of Geraldine Brownlee, Patsy Chronis, Maureen Ellis, Kathleen Gruber, and Mieko Kamii is gratefully acknowledged.

This article by Dr. Constance Kamii gained so much favorable comment when circulated among Teachers' Center participants that it demanded to be shared more widely. With permission from the author, a long-time Teachers' Center friend, we are delighted to make Kamii's constructivist position known through SEEDBED.

Jean Piaget proved, however, that children do not acquire knowledge directly by internalizing it from the environment. With more than 60 years of scientific research, he proved that children construct knowledge from the inside, through interaction with the environment, by going through one level after another of being "wrong" from an adult's point of view. The most obvious example of constructivism is children's learning to talk. French children learn French, and American children learn English. But they learn to talk by constructing grammatical forms that they have never heard, such as "Daddy chair" and "Sit Adam chair." Later, they go on to construct higher-level errors, such as "I brang my lunch" and "My foots hurt." If we try to correct them, they often comply by saying "my feets" and "my feetses." Learning has a coherence of its own at each level, and children construct knowledge in ways that have escaped adult notice for centuries.

Examples of constructivism are so numerous in so many of Piaget's books that it is hard to understand why educators still believe knowledge to be acquired by internalization from the environment. Here is an example of a 7-year-old's construction of astronomy. It is taken from The Child's Conception of the World, a book by Piaget that was published way back in 1926, well over half a century ago.

> You've seen the moon, haven't you?--Yes.--What does it do?--It follows us.--Does it follow us really and truly?--Yes.--Why does it follow us?--To show us the road.--Does it know the road?--Yes. -- Does it know the Geneva roads?--Yes.--

> ...And the roads in France?--No.-- Then what about the people in France? What does the moon do?--It follows them.-- ...Is it the same moon as here?-- No, another one.(p.217)

Three points can be made about the preceding examples. The first is that children are not passive vessels that stay empty until knowledge is poured into them. They are busy constructing their own knowledge, and learn their native tongue on ther own, without any formal instruction. Anybody who has studied a foreign language can appreciate what a feat this is.

The second point that can be made is that children construct knowledge by putting things into relationships. When they say "foots," for example, they do this by categorizing words and constructing the rule of adding an "s" sound to certain words under certain circumstances. When they think the moon follows them, they do this because they put their own movement into relationship with the moon's apparent movement, with reference to a stationany object, such as a tree. Most of us have made similar observations and moved to the right and left several times before concluding that the moon indeed seemed to move when we moved. When children think that the moon knows the road, they have likewise constructed this knowledge by putting things into relationship. Everybody who is older than they are usually knows more than they do. They, therefore, think that a big, moving creature like the moon must also know a great deal. Since children have seen moons of various shapes and sizes, it is not surprising either that they think there are many moons.

The third point I would like to make about the preceding examples is that knowledge is constructed as an interrelated whole, like the development of an embryo, rather than as a collection of bits added from the outside. In the example about the moon, we find elements of astronomy, geography, biology, and psychology. The idea that the moon has knowledge and follows us belongs to biology and psychology, as well as to astronomy. Knowledge is constructed by modification of all these interrelated ideas, and not by the addition of new bits neatly packaged into separate subjects.

I would like to give another example of constructivism, this time with respect to arithmetic. When my niece was about six years old, she counted several times every day the Christmas presents she and her brother had received. One day, she said, "I had only six yesterday, but I have eight today because Grandma gave me two today." She also announced that she and her brother had the same number of presents. She then noticed that the two she received from her grandmother came in the same wrapping paper, and that the six others from different families came in six different wraps. The next statement that came out of her mouth was "How come Santa Claus uses the same wrapping paper as we do?"

Note that children construct addition on their own, too, without any instruction. Furthermore, the natural construction of knowledge is not compartmentalized into subject matters. Mentally alert children go beyond 6 + 2 and even beyond the knowledge about Santa Claus that adults want them to have.

The next example of constructivism comes from Emilia Ferreiro's research on reading (Ferreiro, 1978). Emilia was a colleague of mine in Geneva until she returned to her native land, Argentina. In her research, she interviewed four-to-six year old children who had not yet had instruction in school in reading. She told them, for example, that she was going to write "Papa

PATEA LA PELOTA" in front of the child. She then asked each child if he thought it said "papa" somewhere in what she had written. The children at the lowest of the six developmental levels she found pointed to the first word, "PAPA," in response. She then asked if "patea" ("kicks") was written somewhere. The children in this group answered "No...It doesn't say 'patea' anywhere." She then asked if "la palota" was written somewhere, and the children in this group pointed to the second word, "PATEA". In other words, according to these children, the entire sentence said "Papa patea la pelota," but only the nouns were written, that is, only the objects, Daddy and the ball, were represented explicitly in the text.

Ferreiro went on to ask what the rest of the text said if

PAPA PATEA LA PELOTA
"Papa" "la pelota"

Some children replied, "the football field," and others said "the goal" or "Mummy." For these children, in other words, a written sentence was like a picture. When young children draw a house, they often draw other objects in the background, such as flowers and the sun. When they think of Daddy kicking a ball, they likewise think of the football field, the goal, or Mummy watching Daddy. In a picture, children represent only objects. Actions are too fleeting for them to represent explicitly.

After finding six developmental levels among children who had not yet received any instruction in reading, Ferreiro stayed away while the children were taught reading in the first grade. At the end of the year, she went back to find out if there was a relationship between the six developmental levels she had found and the result of the instruction. She indeed found a clear relationship (personal communication). The children at higher initial levels learned to read, and those who were at low initial levels did not. Children do not internalize directly what is taught to them. They can construct new knowledge only if they are already at a certain developmental level. Imagine being taught to read verbs like "kick," "lick," and "tick" when you don't think verbs are written on paper. At a more advanced level found by Ferreio, children thought that verbs were written but not as separate units. For these children, "Daddy" was one unit, and "kickstheball" was another. Being told to say "kicks," "the," and "ball" as three separate units puts the child in conflict with what he honestly thinks. Constructivist education builds on children's natural constuction of knowledge, rather than imposing new and foreign ideas from the outside.

The best way to describe constructivist education is in contrast with traditional education. Traditional education works like an assembly line in which 20 to 30 bottles are moved from one station to the next, getting a small amount of liquid poured into them at each successive spot. In the first grade, all the bottles are filled up to one-twelfth of their capacity and ready to be sent to the second grade.

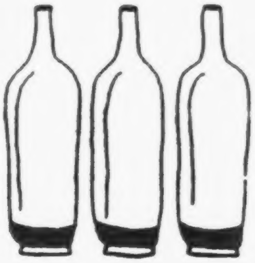

FIGURE 1

Constructivism, by contrast, is a biological view of learning. The fingers of an embryo grow out of the hand by differentiation from it. The leaves of a tree likewise grow out of the plant by differentiation from it. We can change the factors in the environment such as the composition of the soil, the temperature, and the light in which the plant grows, but there is nothing we can do directly to the plant to make a leaf come out of it. Leaves can be grown only by the plant, from within. Traditional education is like trying to grow trees by pasting leaves from the outside. No wonder the leaves get unpasted as soon as the exam is over!

Traditional education assumes that children must be taught everything if they are to know anything worth knowing. Constructivist education is not the diametric opposite that believes children must be left entirely alone to construct their own knowledge. In constructivist education, the teacher gives instruction but believes in the following interactionist principles:

1. Children learn quickly when they are personally interested and mentally active.
2. The long-range goal of education must be autonomy, and not the ability to recite "right" answers.
3. Teachers must reduce their power and encourage children to exchange points of view honestly to foster the development of autonomy in children.

Figure 2 is an example from Geneva of constructivist education. The six-year-olds had played with pieces of transparent plastic tubing and marbles. They had made the discovery that if there are two marbles already in the tube, and a third marble is dropped into it, only the last one takes off, and the one in the middle does not move at all. When the marble that took off comes back down, it is again only the last one that takes off. The children varied the number of marbles inside the tube and put three, four, or five of them in. They found out that no matter how many marbles are initially inside, only the last one took off if one marble came down to hit the entire row. They then varied the number they dropped and found out that if they dropped two, the last two of the row took off, and if they dropped three, the last three took off. Figure 2 is what a six-year-old drew, with lots of arrows that made sense to him, and I changed into English the text that he dictated to the teacher.

Besife tosses the blue marble in.
The one in the middle does not move.
The last one does.
It comes back down and then
the blue one goes toward Besife.

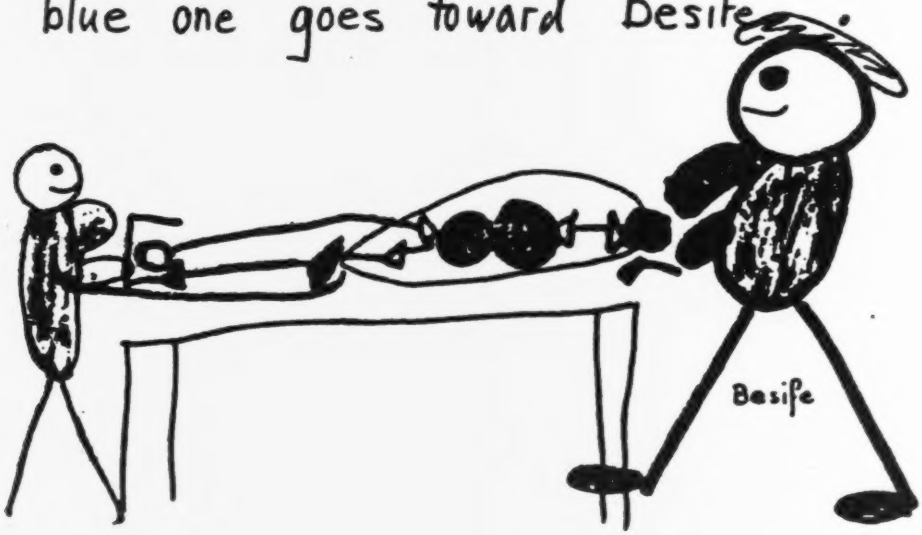

FIGURE 2

This activity cuts across science, arithmetic, and art, and this unfragmented approach is one of the characteristics of constructivist education. If children learn by actively constructing relationships, classrooms must be set up to encourage this constructive process. Children learn to read and write best when they want to say something that is important to them.

My current research on first-grade arithmetic is another example of setting up the classroom to encourage the constructive process in children's heads. The research is being done in the classroom of Georgia DeClark, a graduate of our Master's program in Early Childhood Education. (I asked her to stand up.) We started with two ideas rooted in Piaget's theory. The first one was that if children know what "three" is and what "two" is, they can construct for themselves the sum of three and two, without any instruction. The second idea was that if children repeat the addition of three and two often enough the games, they cannot help remembering the result. In more than six years of research at Circle Children's Center, I had seen many kindergarten children memorize sums with the greatest of ease while playing card games and dice games. By the way, I would like to take this opportunity to ask the current and former teachers of Circle Children's Center who are here to stand up. I won't go through their names but would like to acknowledge their professionalism in practicing constructivist teaching, their willingness to study a hard theory, and the courage of their conviction. Based on my experience at Circle Children's Center, I asked Georgia to throw out of her arithmetic program all instruction and all worksheets, and to use instead only two kinds of activities--games and situations in daily living such as the counting of votes to make a decision.

I am against worksheets because children learn the wrong things from them and very little that is positive. For example, if a child already knows the sum of three and two, he does not learn anything new by writing the answer. If he does not know it, having to write the answer after counting on fingers prevents him from remembering the numbers. When a first grader thinks about how to write "5," he cannot think simultaneously about "three" and "two." Furthermore, once he writes the answers, he turns the worksheet over to the teacher, and the responsibility of checking the answers is handed over to the teacher. When the corrections come the next day, children cannot remember what they did and usually don't even care. They are thus ready to make the same errors all over again. Through worksheets, children also learn that the truth can come only from the teacher's head.

Group games are much better than worksheets because if, for example, a child says that 3 + 2 = 6, he is likely to be corrected immediately by the other players. If you are not convinced that children are mentally more active in games than while working on worksheets, I suggest that you observe them in both situations. In a dice game, children do not only do their own addition but also everybody else's work as well.

The children in Georgia's class last year thus did not have any instruction in first grade arithmetic. At the end of the year, however, they came out slightly better than the group who had been taught in the traditional way, through worksheets and flashcards. We learned, furthermore, that children do not memorize sums in the order expected by adult common sense. In the Instructional Program of the Chicago Public Schools, for example, children are expected to know sums through ten in the first grade, and sums through eighteen in the second grade (Board of Education of the

City of Chicago, 1981). This sequence appears reasonable to adults, but children do not construct knowledge in such a reasonable way. Any number plus 1 or 2 is easier than many small sums through 10. For example, 1 + 15 and 10 + 2 are taught in the second grade, but these are easier to remember than 3 + 5 that is expected in the first grade. Certain "doubles" such as 10 + 10 and 6 + 6 are likewise taught in the second grade, but these are easier to remember than 3 + 5 that is expected in the first grade.

I spoke so far about reading, writing, arithmetic, and science as if constructivist education were just another way to teaching the same thing that traditional education has taught. This impression is misleading. Constructivist education has goals that are different from traditional goals. The aim of constructivist education is autonomy, which I envision as shown in Figure 3 in relation to the objectives of traditional schools. Autonomy means being governed by oneself. It is the opposite of heteronomy, which means being governed by someone else. An extreme example of intellectual autonomy is found in the work of Copernicus, or the inventor of any other revolutionary theory in the history of science. Copernicus published the heliocentric theory in 1543, when everybody else believed that the sun revolved around the earth. He was laughed off the stage by his fellow scientists, but was autonomous enough to remain convinced of his own idea. An intellectually heteronomous person, by contrast, lacks the initiative to question what he is told, including illogical conclusions, slogans and propaganda.

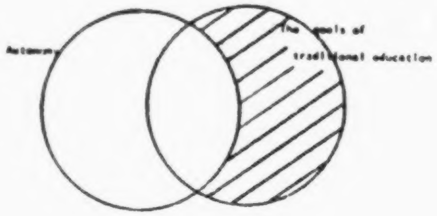

FIGURE 3

A more commonplace example of intellectual autonomy is my niece, whom I have already mentioned. She had been taught that Santa Claus brought her presents, but did not accept uncritically what she had been told. Her asking "How come Santa Claus uses the same wrapping paper as we do?" is an example of intellectual autonomy. After her mother gave her an "explanation," she went on to ask one more question: "How come Santa Claus has the same handwriting as Daddy?"

Worksheets encourage heteronomy, that is, obedience, submissiveness, dependency, and, in short, being governed by somebody else. It is the teacher who decides which worksheets are to be completed and when, and the teacher decides which answers are correct. When games are used, on the other had, the teacher is neither omnipotent or omniscient. In games, it is the children who decide which game to play and with whom. It is the children who check each other's answers and decide what to do if someone cheats. Games thus encourage children to become more autonomous socially, morally, and intellectually.

The shaded part of the circle to the right (labeled "The goal of traditional education" in Figure 3) stands for things we memorized in school just to pass one examination after another. All of us who succeeded in school achieved this success my memorizing an enormous number of "right" answers without understanding them or caring about them. All of us have experienced the relief of being free to forget the things we memorized only to pass a test. We made these efforts mostly because we were good, obedient, heteronomous conformists.

The result of this kind of education is what McKinnon and Renner (1971) and Schwebel (1975) found in their research on college freshmen's ability to think logically at the formal operational level. These college students were the "cream of the crop" in elementary and high school who were successful enough to enter the university. The percentage of college freshmen found by McKinnon and Renner to be capable of solid logical thinking at the formal level was 25. The percent found by Schwebel at Rutgers University was only 20.

Ability to think logically at the formal level belongs to the circle labeled "Autonomy." More precisely, it belongs to the part of the circle that does not overlap with the other circle, since so few college freshmen seem to have formal operations after being successful in secondary school. After presenting their findings, McKinnon and Renner asked what kind of education these university students received in high school. They concluded that high-school students are not taught to think logically, and that if high-school teachers do not emphasize logical thinking, we must ask who trained these teachers. Their answer was: Universities did. In other words, schools underemphasize thinking from beginning to end. If students cannot think logically at the formal-operational level, they can certainly not think critically or autonomously.

The intersection between the two circles stands for things we learned in school that were useful to our development of autonomy. The ability to read and write, to do arithmetic, to read maps and charts, and to situate events in history are examples of what we learned in school that are useful for our adaptation to the environment. If autonomy is the aim of education attempts must be made to increase the area of overlap between the two circles.

Autonomy as the aim of education implies the need to rethink everything we do in the name of education. I do not have anything against "good" behavior, "right" answers, or the three R's. I am, in fact, all for them.

But there is an enormous difference between a correct answer autonomously produced with personal conviction and one produced heteronomously by obedience. There is likewise an enormous difference between "good behavior autonomously chosen and "good" behavior practiced through blind conformity.

I am sorry not to have enough time to discuss the moral aspect of autonomy, which is a large part of the circle to the left. For those who are interested, I wrote a paper you can have entitled "Autonomy As the Aim of Education" (in Kamii, 1982). I would simply like to point out that the Watergate coverup affair was produced by obedient adults who were governed by others through rewards and punishments. Reward and punishment result in three possible outcomes: calculation of risks and costs, blind conformity, and sometimes revolt. Educators must try to raise children who can judge autonomously what is right or wrong, independent of what leads to a reward or to punishment.

I would like to give an example of a sixth grade teacher in Geneva who taught grammar in a way that fostered children's intellectual autonomy. The class was learning to diagram sentences, and the group was divided into six subgroups of four or five pupils each. When I arrived after lunch, the teacher put a rather tricky sentence on the board and gave the groups 20 minutes to diagram it. When the time was up, a representative of each group went to the board and put a diagram on it. Two of the six were immediately erased, as they duplicated two other groups'. Individual students then offered well-reasoned arguments in favor of one diagram, or to show that one was inadequate. The author of the version under attack would then defend it vigorously. The arguments thus continued with intensity until it was time for recess. By that time, everybody had agreed that two of the four versions could not be defended and had to be erased.

When the children returned from recess, the teacher asked if the class wanted the answer. Some said "Yes," but others answered, "No, because you'll give us the wrong answer just to see if you can trick us." The teacher admitted that he indeed intended to do that. The arguments and counterarguments continued, and the class finally agreed on the superiority of one diagram.

This class spent an entire afternoon on one sentence. But I was left with the impression that the children thought so hard about each well-articulated idea that they were thoroughly convinced in the end of the superiority of the final version. Many pupils offered wrong ideas along the way, but they were encouraged to defend their opinion until they were convinced that they were wrong. Children learn by modifying old ideas, rather than simply by accumulating new bits. A debate about the superiority of one diagram or another is good because it encourages children to think critically by putting different opinions into relationship, and modifying old ideas when *they* are convinced that a new one is better.

I hope the similarity is clear between this example about sixth grade grammar and the one I gave earlier about games in first grade arithmetic. An important principle of teaching in constructivist education is that children be encouraged to exchange points of view. If one child thinks that 3 + 2 = 6, and another child has a different idea, it is much better corrected by an omniscient teacher. This principle of exchanging honest opinions can be used in any subject at any age level, including the university. Children become much more interested and responsible when they are asked to defend their own personal, honest ideas than when they are made to recite "right" answers.

Constructivist Education As a Direction for the Twenty-First Century

Why am I convinced that constructivist education is a direction for the twenty-first century? Earlier, I noted that when Copernicus published the heliocentric theory in 1543, he was jeered by his fellow scientists. But today, only 400 years later, no one doubts the truth of the heliocentric theory. It is natural for people to resist new theories (Kuhn, 1962), but the evidence is too consistent from too many cross-cultural studies to cast any doubt on constructivism. I have seen behaviorist associationists, and empiricists change over to Piaget's theory as I did, but I have never heard of a Piagetian who later became a behaviorist, associationist, or empiricist.

I think, however, that constructivist education is a direction for the twenty-first century, rather than for next year or even the coming five years. Change will take time partly because constructivist teaching is the hardest kind of teaching ever invented. It is much easier and less threatening to follow a teacher's manual, go through reading groups day after day, give and correct worksheets, and make routine lesson plans for the entire week. Constructivist education requires that the teacher understand how the child is thinking and feeling, and raise an occasional question or make a tactful suggestion. The drawing shown in Figure 2 was made at the teacher's suggestion. The idea of writing the text was also initiated by the teacher. But if the child had refused these suggestions, the teacher would have respected the child's wishes. A child who feels respected today is more likely to accept a suggestion tomorrow than one who feels he was forced to submit to adult power.

The most difficult part of constructivist teaching is that it requires change, not only of a teacher's method of teaching, but also of his entire way of thinking about himself. It is extremely hard for a teacher to stop being the all-powerful, all-knowing center of the classroom. It is likewise extremely hard for an administrator to stop being a factory manager who supervises the mere filling of bottles. I think, in fact, that for the great majority of teachers and administrators already on the job it is impossible to change because it is too threatening to give up our adult power.

When a teacher finally takes a heroic contructivist step, he or she usually comes in direct conflict with a principal. For example, a teacher in the Chicago Public Schools who is in this audience decided to use the discussion approach to teach composition. She got the group to suggest how each child's composition might be improved. She saw that this method dramatically improved the children's interest and quality of thinking. However, her Principal commanded her to correct every single error on every single paper. Principals and others in power have already reached the tops of the ladder and are far from the "nitty-gritty" of teaching real children. There is, therefore, little, if any, incentive for them to study a new and difficult theory and change their entire way of viewing their existence.

For a teacher who has gone through our Master's Program in Early Childhood Education, having to continue teaching in ways that are now against their conscience is intolerable. Some fight the system for a few years and end up leaving it. Some of the teachers who have taught at Circle Children's Center had also taught in public schools. They came to Circle Children's Center after concluding that teaching in accord with their conscience was more important to them than the higher salaries they were receiving in public schools. Many other teachers all over the country have likewise been leaving public schools after learning about child development in graduate schools.

I am afraid the smoothest way to change over to constructivist education is to wait for the old generation to retire and make room for the younger generation. I further think it will take two or more generations for education to change.

But can parents wait for two or more generations? For years, parents at Circle Children's Center have asked the staff to recommend schools for their six-year-olds. Unfortunately, the response has been that we don't know of any school, either public or private, that is based on constructivism.

The most recent case is that of Mrs. Carrie Palmer. (I asked her to stand up.) Her daughter attended Circle Children's Center happily for three years and eagerly went to first grade in a magnet school. After the first week, however, her child began to cry and to say that she did not want to go to school any more. In her new school, she was made to read when she was totally uninterested in reading. While the teacher went through her reading groups, the children spent literally 80% of their time filling out worksheets. Furthermore, they were required to work in silence, and silence reigned through most of the day. If you believe in constructivism, you immediately recognize this classroom as being harmful to children's social, moral, and intellectual development.

To make a long story short, Mrs. Palmer ended up taking her child our of the public schools on October 8, only one month after the beginning of the school year, and enrolling her in a private school, where the teacher is kind but worksheets are still the main staple of intellectual nourishment. The justice is that this kind of harm is being done to children with tax money and compulsory attendance laws, about which parents have absolutely no choice. There is no school in the entire public school system now whose aim is the development of autonomy in children.

The best solution to this problem, I think, is for public schools to provide more alternatives. Autonomy as the aim of education is preferred by some parents, some teachers, and some administrators. The great majority, however, prefer the traditional, tried-and-true approach. The traditionalists, too, have a right to the kind of school they prefer. The injustice now is that, no matter what a magnet school has to offer, it still does not offer autonomy as the broad aim within which each content is taught. Whether we teach arithmetic, science, poetry, or history, we teach it very differently when our broader aim is the development of autonomy.

Young children are vulnerable and completely at our mercy. The three-, four-, five-, and six-year-olds at Circle Children's Center have their futures ahead of them. The ten years of compulsory public education they will have can make an enormous difference in the kind of human being they will turn out to be. It troubles me very much to think that they may have the kind of coercive, comformist education that most of us had.

It will not be easy to make constructivist education a reality. But in my 14 years of curriculum research with teachers, I have been amazed by how inventive, resourceful, and knowledgeable teachers can become when thye have Piaget's theory as a conceptual tool. I have also been deeply touched by teachers' professional conscience. They get punished for following their conscience, but they have a strong desire to do what is best for children.

There is thus a growing constituency of teachers who advocate autonomy as the aim of education. There is also a growing constituency of administrators, especially in California, who are working hard for constructivist schools. I have approached some administrators of the Chicago Public Schools about the possibility of setting up a magnet school where autonomy would be its aim. The initial reactions I have received so far have been positive, and I intend to pursue these dialogues. A third constituency is parents like Mrs. Palmer who know how damaging it is for children to be pressured and forced silently into a mold. These parents, teachers, and administrators are now scattered all over the City, and I would like to encourage them to get together to work for an alternative school.

When Circle Children's Center was born only ten years ago, we did not dream that it would become the kind of school that attracts visitors from abroad. I have given many lectures, both in this coutry and abroad, on autonomy as the aim of education. The reaction everywhere has been enthusiastic and sober.

There are, in fact, many teachers in this audience who would transfer tomorrow to a constructivist school if such a school were created. Many parents would also work hard, just like the parents who supported Circle Children's Center all the way through its infancy and vulnerable years. The task ahead will be arduous, but many of us are willing and ready to work hard to make schools a better place for the next generation.

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HUMAN BECOMINGS

R. Lynn Bradley

In his article, "What's Basic? A Constructivist View", Thomas C. O'Brien makes the following statement: "It's as though we should all, children especially, be seen as wearing sandwich boards saying 'Under Construction' or even better, 'Under Construction--Self-Employed'"

That statement provoked the question, "What are we?" We refer to ourselves as "human beings". The term "being", in at least one sense, implies something that is static. If what Professor O'Brien has said is true, then we are certainly not static. Rather, we are constantly changing and moving toward some new state or level of existence. We are then, in a sense, throughout our lives constantly in the process of development.

If we are always developing, then why don't we call ourselves "Human Becomings"?

INSTEAD OF THE USUAL

Audrey M. Dibble

This year I did not start my students off on page 1 of the math text the second day of school. I decided that it would be a good time to really try some of the problem solving activities that I had learned from the summer course and from some of the readings I've done since then.

My timing was perfect because the students were enthusiastic about being back and were curious about finding solutions to the new activities and they hadn't yet focused on a text page number. They were willing to use a new perspective in dealing with math. The purpose of these activities was not only finding a correct answer but how many ways could this answer be reached. Even the slow learners and former behavioral problem students have demonstrated a new interest in math because they do not have to worry about relying on their memory to solve a problem.

Now that we are working from our texts, the students still enjoy sharing different approaches and different points of view concerning problems. I have students for whom I do not have to assign homework. All I have to do is present the challenge and they enjoy working on it until they solve it.

Since there are certain things I am required to cover during math class, I chose to use one of my planning periods each week for a math club. Finding problems, setting them up and working on solutions is all that we do during those times.

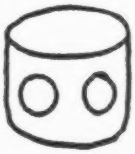
The math club is very popular in the school because the only requirement is the desire to participate. There are no grades, therefore, pressure is nil. As of last Wednesday (September 22), 35 students had joined and enrollment is steadily increasing. I will eventually have to divide the group into three sessions to accommodate all interested students. Also, it is not unusual to walk into the room and see staff members that have a free period involved with the group, enjoying themselves solving problems. Many students and teachers have commented that this approach to math is relaxing and interesting.

The only problem I have now is in keeping up with my students. However, I feel that I have started something at our school that will soon become a tradition.

MAGNIFY WITH EASE

Donna McBride

Take a gallon (or larger) bleach bottle and cut it just below the handle.



Cut three holes around the bottle large enough to get you hands through. Place saran wrap on the top of the container and secure it with a rubber band. Take the magnifiers outside on a sunny day and let the children

from nature and bring them to the magnifiers. Pour a small amount of water on the saran wrap and place your article under the magnifier through the holes. Is the article larger? Is it smaller? Do you need the sun? What would it look like in the shade? In the room? Can you see your finger prints? What other things can be done with this magnifier?

Editor note: Is the water needed? Why? Will other liquids work -- oil, vinegar, 7-UP, etc.?

MORE THAN? LESS THAN?

Janice M. Hawthorne

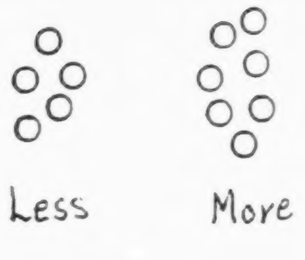
During the summer months I had an opportunity to read Elementary Mathematics Activities--Part A. by Hassler Whitney. As a first grade teacher (with 32 pupils) I needed simple ideals of teaching basic mathematics on a level on which all of my students would be most comfortable. Below is the math exercise which I have used with much success in teaching my first graders "more than" and "less than".

Very young children seem to have a real feeling of big, small, strong, weak, good, bad. Although they may not be able to verbalize their ideas, the concepts of more and less follow closely on these. Many math texts ask children in early grades to put the correct sign, $\rangle$ or $\langle$ between number pairs such as 22 $\rangle$ 18; 9+2 $\langle$ 6+7. This is usually frustrating for them. I suspect that it is the language that throws them.

Getting children to understand new meanings and then how these ideas are verbalized is the normal and best way. Story problems--"Which child had the most?", "Was Aimie taller or shorter?" will lead to this understanding. Sentences like "John is big" or "Tim is small" are easy to understand.

Comparing ideas is harder. "Tony is bigger than Sam" or "Sam is not as small as Jim" are more difficult for young children. Go easy on such sentences at first. (The children may well understand them, but they probably will not be able to verbalize their understanding.

Activity: Larger, smaller numbers. Let the children draw pairs of patterns of dots (not too many in each). Then let other children look at each pair, pointing to one: "More" and pointing to the other: "Less" or

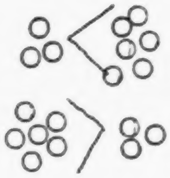


pointing to both: "The same".

Then do the same but using numerals instead of patterns. The children could use the words "larger" (or "bigger") and "smaller".

9 Less 12 More

If you really want the children to use the inequality signs, introducing them after the children are comfortable using the words "more" and "less" makes much more sense.



$3 < 6$

$6 > 3$

THE DAILY PROMENADE

Jeanne Scropos

Years ago, when girls were called young ladies and were never permitted more violent exercise than walking, the headmistress of a boarding school wished to arrange matters so that her pupils would derive the maximum amount of companionship in their daily walks without forming boisterous groups. She therefore ordered the young ladies, of whom there were 2n, to walk in pairs, but to form new pairs each day in such a way that no young lady had the same companion a second time before she had walked with every other young lady. This worked well for a day or two, but presently the young ladies began to spend more and more time each day trying to find partners. They would be nearly ready when it was discovered that the last two young ladies had already walked together. Can you help the headmistress?

PEG-IT

Helen Miller

Materials: Each player has a peg board.

Each player has 10 pegs all the same color.

One die.

Method: Each player puts his respective pegs in a straight line on his peg board. After the amount is verified and the child visually identifies 10 pegs on his board, the pegs are removed and put on the table next to his board.

Play: The first player rolls the die. The number of dots on the top determine the number of pegs he is able to play on his board. Each player in turn follows the same procedure.

The object of the game is to get all 10 pegs on the board. If the player rolls a number that is larger than his total number of pegs he has left to play, he forfeits his turn. The game continues until every player has been able to play all ten of his pegs.

EVALUATING COMPUTER PROGRAMS FOR PRE-SCHOOLERS

Judy Maxson

One of the topics discussed at length in our summer workshop was the evaluation of computer programs. As teachers, we need to have some criteria for judging the value of computer software not only for classroom use, but also in order to recommend worthwhile programs to parents who may ask our advice.

I have been interested in the growing number of computer programs for pre-school and primary school children. There seems to be an increasing awareness that early familiarity with computers may not only be beneficial educationally, but may promote and encourage a generation of children who have developed computer literacy even before reaching formal schooling.

When considering computer programs for pre-school and primary school children, it is well to keep in mind what makes these children unique members of the computing population. Keeping some of their characteristics in mind should help us to judge why one program is good while another may not be (for them).

1. Many children in this population can't read. Therefore, communication between the computer and the child must not rely on written language. The program must communicate with the computer's graphic or sound capabilities.

2. Pre-schoolers and many primary children do not have well-developed problem-solving skills. They understand only simple cause and effect problems, with immediate results and actions.

3. They have not developed good coordination or reaction times. They do not do well at tasks which require their hands to be doing different things at the same time.

4. They have a relatively short attention span, and generally become easily frustrated. (Kimmel, 1981, p. 44-46).

Glenn Kleiman and Mary Humphrey, writing in Compute! magazine (May, 1982, p. 106-108), give these principles of software design for young children. I feel they are useful when attempting to evaluate programs aimed at pre-school and primary age children.

1. The program should be easy to get started. An adult should not be continually required to set up the program before a child can use it.

2. The program should make it easy for the child to understand how his actions cause things to happen. A child should be able to learn by realizing the relationship between what he does and the action that results on the computer.

3. The program should make it easy for a child to enter responses. A minimal number of key presses should be utilized, and provisions for erasing and reentering responses are helpful.

4. The program should allow the child to work at his own pace. They should not move too quickly and cause frustration, or so slowly that they become boring.

5. The program should hold the child's attention, but should not distract from important information. Too much color, sound, or movement may be confusing or distracting.

6. The child should be easily able to understand the feedback. He must know whether his answer is right or wrong, and this information should be presented in a friendly, appropriate way. Smiling and frowning faces are effective feedback devices.

If computer programs developed for pre-school and primary children incorporate these principles of design and have sound educational content, appropriate to this age group, they can be useful additions to the child's world of learning.

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Kleiman, Glenn, and Humphrey, Mary. "Learning With Computers." Compute!, May, 1982, pp. 106-108.

COLLECTIONS TO MANIPULATE

Lisa Quick

Around the home and school are many common objects which can be used to develop whole number addition and subtraction concepts. Here is a sampling:

- pebbles
- bottle caps
- straws
- washers
- paper clips
- coins
- pencils
- crayons
- coffee stirrers
- nuts and bolts

I ask children to bring twenty objects of some kind from home. The children trade the collections every couple of days. This allows them to work on addition and subtraction concepts with a variety of manipulative aids. This variety is important because before children can learn that mathematical concepts are context free, they must experience those concepts through many kinds of materials.

When concrete materials are no longer needed, children can then write equations and draw pictures or use number lines to find sums and differences.

WHO IS ON THE FIFTY DOLLAR BILL?

Jeanne Edgar

A mother said to her daughter who needed some money for a blouse, "If you can tell me the name of the person on the ten dollar bill, then you may have this bill." The daughter said she did not know. So the mother hinted, "It's a president. For example, Washington is on the one dollar bill." The eleven year old replies, "If Washington is on the one dollar bill, then the 10th president of the U.S. must be on the ten dollar bill."

I thought this was good logical thinking, so I asked one math class the same question and got the same response. Children's minds must think alike!!??

I liked this theory and so I continued, "Who is on the twenty dollar bill?" The class said that the 20th president would be on the twenty dollar bill. I told them I didn't know who the 20th president was but that I did know that Abe Lincoln was the 16th. The class then figured that the 4th president after Lincoln would be on the twenty dollar bill.

Then I asked, "Who is on the fifty dollar bill?" The answer was, "Whoever the 50th president was!" Someone knew that Kennedy was the 37th president. No one knew the number of President Reagan. So they figured it out: Kennedy-37, Johnson-38, Nixon-39, Ford-40, Carter-41, Reagan-42. So no one must be on the fifty dollar bill.

Back to the question! If no one is yet on the fifty dollar bill, when will we have a 50th president to put on the fifty dollar bill? What if every president served 1 term or 4 years? What if every president served 2 terms or 8 years? We reviewed the law that says that no president can serve more than two terms as president.

This chart followed:

1 Term	2 Terms
1980 - 42nd	1980 - 42nd
1984 - 43rd	1988 - 43rd
1988 - 44th	1996 - 44th
1992 - 45th	2004 - 45th
1996 - 46th	2012 - 46th
2000 - 47th	2020 - 47th
2004 - 48th	2028 - 48th
2008 - 49th	2036 - 49th
2012 - 50th	2044 - 50th

What if some presidents served two terms but others served only one term? Conclusion: Then the 50th president would be somewhere between the years 2012 and 2044.

Is there any way possible that we could have a 50th president before 2012? Answer: Yes, we could if someone dies and/or doesn't serve as president for four full years.

Now who do you think will be on the hundred dollar bill? Answer: That's too far away into the future to care. There probably won't be any hundred dollar bills or money of any kind by then. All exchange will be done by computers!

SOME RAMBLINGS

Vina Houchlei

...Quite honestly, if I were to completely apply Piaget's theory to my classroom, I would need to include more hands-on activities. I do a great deal of discovery activities, but too often I pose the problem. They are not self-discovery activities based on the child's need. Too often, I provide the means to answer my questions, not necessarily their questions. I fall into the trap of providing an answer before the question has been asked. As teachers, we sometimes forget that students cannot learn only through paper-and-pencil activities but need to use manipulative materials too. We also tend to forget or ignore the need for the students to act upon one another's ideas....

TEACHING THINKING

Beverly Ostendorf

> "There are lots of different ways of looking at things and of thinking about things. But I guess you have to find out about them for yourself. You get taught that there's only one way to think, and then you find out there are a lot of other ways that may be just as good. I'd like to find out all the different ways in which it's possible to think."

The profound statements above are spoken by Harry Stottlemeier, one of Matthew Lipman's characters in his book, Harry Stottlemeier's Discovery. Lipman invented the modern, midget Aristotle (hence the name "Stottlemeier"), as a means by which teachers can teach philosophy and logical thinking to elementary school children. The idea of teaching philosophy to young children is Lipman's way of teaching youngsters how to think.

While teaching philosophy at Columbia University, Lipman became painfully aware of the low level thinking skills his students possessed. He realized that these poor thinking habits were developed early--probably during the first six years of school. He discovered that the questions teachers tend to ask are of a literal nature: "What are the names of...?", "What was the first...?" and "Who discovered...?" Rarely do teachers ask higher level thinking questions, those that are evaluative and interpretive. Situations in which children use problem-solving skills are not generally part of the curriculum.

Lipman's story begins with his main character daydreaming during class one day. Harry vaguely hears his teacher explaining that all planets revolve around the sun, but misses the lesson about other terrestrial objects revolving around the sun--comets. The teacher then asks Harry the question: "What is it that has a long tail, and revolves around the sun every 77 years?" Harry recalls some of Mr. Bradley's earlier lecture and responds, "Planets." Laughter ensues and Harry is left embarrassed and confused as the dismissal bell rings.

In defense of his blunder, Harry begins constructing sentences (ideas) on his way home--"All planets revolve around the sun, but not everything that revolves around the sun is a planet." Harry forms an hypothesis: You can't reverse sentences. "If you put the last part of the sentence first, it'll no longer be true." He tests more sentences and becomes excited with his discovery. His friend Lisa, however, disproves his theory of reversing sentences by offering, "No lions are eagles." It is at this point that Harry realizes how complicated and rule-bound logic can be.

Lipman thickens the plot by introducing more classmates who become involved in Harry's search for additional ways of thinking. While a meager thread of a plot weaves its way through the story, the emphasis is on the adventure of discovering the laws of logic and of quality thinking.

Through the help of his math teacher, Harry and his classmates find that many sentences can be tested for accuracy by the use of a standard form:

All classes are interesting.

Some classes are interesting.

No classes are interesting.

Some classes are not interesting.

With this information, Harry begins evaluating every-day problems and situations to find untruths:

All lawyers are people who favor civil rights.

All radicals are people who favor civil rights.

Therefore, all lawyers are radicals.

Harry recalls an earlier conversation with his father concerning smoking and concludes "that at first his father hadn't liked smoking, but after he tried smoking for some time, he got to like it, so that now his liking it was the cause of his smoking, whereas at first, his smoking was the cause of his liking it. What starts as the cause may wind up as the effect."

Through classroom discussions the children begin to systematically develop complex ways of observing and evaluating the world around them. They receive encouragement and guidance from their teachers, but the children in Lipman's book (and real ones too) honestly enjoy asking and answering questions, making distinctions and learning that one needs reasons to back opinions. Children learn to appreciate truth and fairness!

Lipman, Matthew, Harry Stottlemeier's Discovery. Institute for the Advancement of Philosophy for Children, Universal Diversified Services, Inc., West Caldwell, NJ, 1971.

SQUARE OFF

Beverly Ostendorf

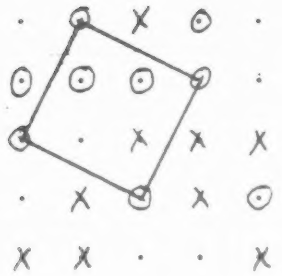
This activity is for two players.

You will need a 5 by 5 dot grid.

Rules:

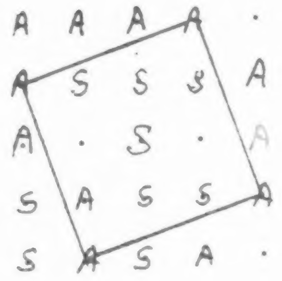
1. The players take turns marking one of the dots on the grid. One player marks O and the other X. (Use initials if you wish.)
2. The object of the game is to force one player to make four marks (initials) on the corner of some square.
3. If one player has four marks on the corners of a square, the other player wins the game.

Some sample games:



O loses game

X wins



A loses game

S wins

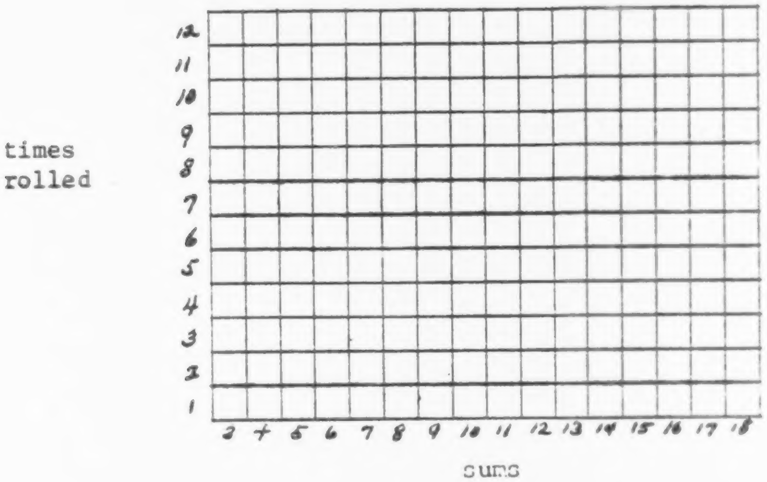
WHICH SUM WAS ROLLED THE MOST OFTEN?

Judy Miles

This activity can be done with one child or a small group of children. Three dice are needed. Before beginning, the player(s) must state how many turns will be taken. The player rolls the dice and finds the sum of the numbers shown on the three dice. The sum is colored in on the graph. After the stated number of turns are taken, the player checks the graph to see which sum was rolled the most times.

Questions To Consider

1. Why was this sum rolled more than the others?
2. What were the chances for rolling this sum?
3. What sums have the greatest chance of being rolled? Why?
4. What sums have the least chance of being rolled? Why?
5. Are there factors at work here other than the laws of probability?



EASY AS TIC-TAC-TOE

Dennis O'Neill

Tic-Tac-Toe is a simple game played between two persons of almost any age...or is it so simple? Think about how games such as Tic-Tac-Toe, checkers or even chess start out as games of trial and error for children but often progress to rather complex and thought provoking problem solving activities for adults. And this is not to degrade them but to praise them. They're wonderful! They're important!

They make us think and think again as we adapt to each new situation. We learn to plan. We learn to be logical. We learn to think about consequences and we learn from poor decisions. And just like vegetables, we can enjoy them without caring that they're good for us!

Here is a simple game we used to play in high school which I have never seen played anywhere else. It's simple!(???) Start with two players and four rows of dots arranged as follows:

Row 1 (one dot) .
Row 2 (three dots) . . .
Row 3 (five dots) . . . . .
Row 4 (seven dots) . . . .

Object of the game: Make the other player circle the last dot!

Rules:

1. You must circle at least one dot on each of your turns.
2. Dots may only be circled in rows (horizontally), NOT columns or diagonals.
3. You may circle as many (or all) dots in any one row as you wish but you must stay in one row per turn.
4. You DON'T have to start at the beginning of a row; you may circle the dots in the middle if you wish.
5. You may start with any row and choose any row on each of your turns.

READING FUN

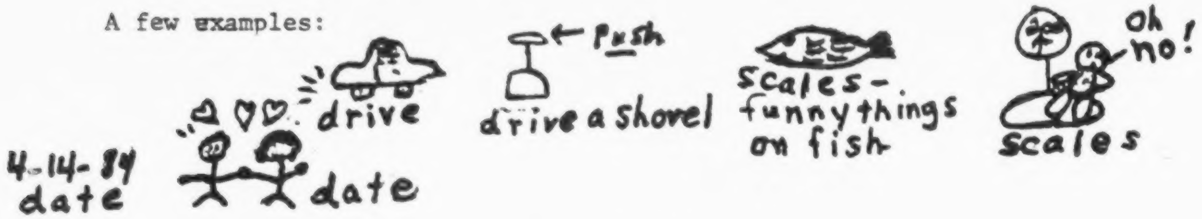
Sharon Allison

The first day I stepped into my new role as a reading teacher to a group of junior high learning disabled youngsters, the word "challenge" flashed brightly in my mind. I knew many of the students lacked the motivation to read because of their past failures and their skill deficiencies in this area. With a silent "thanks" to Shirley Casey and Tom O'Brien for putting activity learning foremost in my mind, I am currently attempting to help these children see that reading _can_ be enjoyable.

One of our first class activities was to compile a list of "things we read". After the obvious choices of books, magazines, and newspapers they started to really think. Ideas began ranging from road maps and driver's license tests to menus and designer labels! We decided to break into small groups, make lists and then compare. After much brainstorming, the lists were presented and groans could be heard ea time an idea was presented which others had missed. Each student wa truly involved and interested, and days later they would come into class with "I thought of _another_ thing to read".

When the teacher is working with one reading group, the other students often have independent reading and seat work to do. As a change of pace, I handed out flash cards to a group not working with me at the time. Each card had one word on it and each word could have two or more meanings. The students were instructed to work as a group and make a chart showing the multiple meanings of each word. Because writing is difficult for some of these children, I told them they could explain a definition with words and/or illustrations. The results have been excellent, and the students have started thinking of additional words to include on their charts.

A few examples:



This activity resulted in much student interaction, cooperation and enthusiasm in learning from one another.

We have a "reading corner" in our room which is going to change monthly. Each month there will be a new display of books, articles, activities and varied material pertaining to the theme of that month. For example, in October, an eerily decorated counter will contain Halloween stories, crossword puzzles, suggested activities and mystery books. The students are encouraged to bring in appropriate books or stories they would like to share. These are ideal for those "free reading" times and are usually things children want to read.

I'm sure these ideas and variations of them have been used before, but I've included them here because teachers do learn from each other. I've learned many things from my Teachers' Center encounters and will be using this knowledge throughout the school year!

TREASURE HUNT

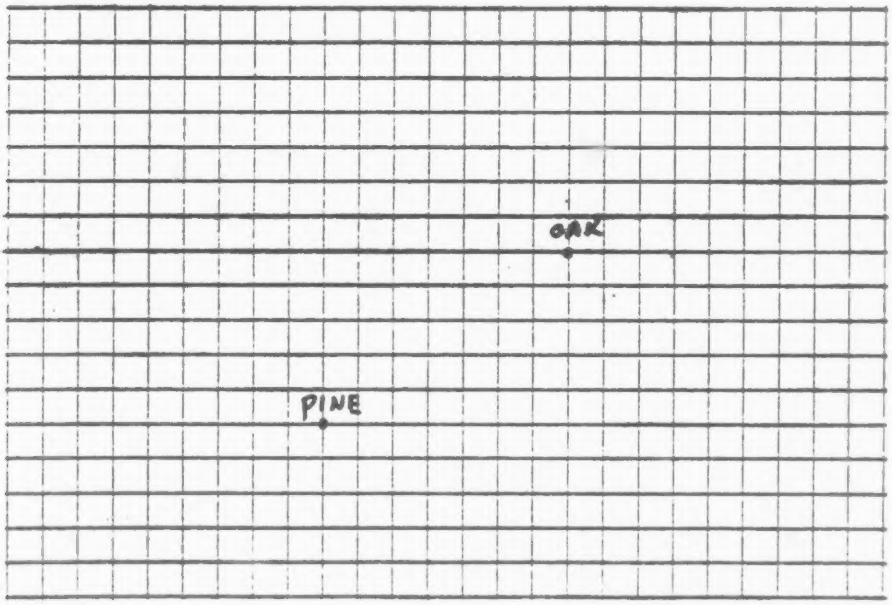
Mary Ann Tieman

Two boys found an old treasure map. Instructions on the map told how to find the island and the treasure that was buried on it. Instructions for finding the buried treasure read:

> "Near the shore you will see a single oak tree and a pine tree. You will also see an old gallows on which we once hung traitors. Start from the gallows and walk to the oak tree counting your steps. At the oak, you must turn right by right angle and take the same number of steps. Put a spike in the ground at that point. Now you must return to the gallows. Begin again from there, but this time walk to the pine tree counting your steps. At the pine you must turn left by right angle and see that you take the same number of steps, and put another spike in the ground. Dig halfway between the spikes; the treasure is there."

When the boys reached the island, they found the oak tree and the pine, but the gallows was gone. There was absolutely no trace of where the gallows once stood.

The treasure is still there. Can you find it?



This activity is adapted from a book, One, Two, Three,...Infinity. by G. Gamow.

THINKING TRAYS

Linda McDonnell

While I was reading Mathematics in Primary Schools, I read that language is a fundamental part of learning mathematics. Before the children were given such problems as 3 + 2 = ( ), they were given toys to play with. While they were playing, they were asked to tell a story about the toys. One child told this story about his horses. "There were 8 horses on my tray. I took 5 out. There were 3 left." Then he recorded his results in symbols too: 8 - 5 = 3.

I decided to give this a try in my classroom. I got 12 trays and 12 each of toy horses, dogs, cars, farm animals, dinosaurs, zoo animals, etc. Each day the helper may choose whatever he wants for each tray. For example, the helper might choose 12 cars to go on the 12 tray. He might choose 8 dinosaurs to go on the 8 tray and so on. (I was surprised at the number of counting difficulties I observed among the children. For example, Bill, one of my better students, had 4 insects on the 3 tray.)

Then at math time, we began by using the 12 tray with the cars. I told this story: "8 cars were parked in a parking lot. Later, 4 more cars pulled into the lot. Then there were 12 cars in the parking lot." I said that I could write this another way, 8 + 4 = 12. Then the children took turns and told stories about the items on their trays. They also wrote the appropriate number sentences. We had a lot of fun!

Another activity that we did was a spin-off of the first idea. We had a page in our math workbooks with computation problems on it. It began with 3 + 1 = ( ). I told the children that I had seen many things, but I had never seen 3. I'd seen 3 birds and I'd seen 3 red trucks, but I'd never just seen 3. They said that they hadn't either. So I said, "Let's make up our own stories." Then the 3 + 1 = ( ) became: "I went to the store and bought 3 candy bars, Then I went back and got 1 more candy bar. Now I have 4 candy bars all together."

The children couldn't wait to tell their own stories. While they were telling their stories, we all moved counters on our desks. The counters could be whatever we wanted them to be. In the above story, the counters were candy bars. Sometimes, the counters were funny. Sometimes they were scary. But the main thing was that we were adding things, not just symbols. And as a result, everyone had success. There were few incorrect answers.

After we all had a turn at telling our stories, we each got partners and alternated telling stories to one another. As the children were working, I went around and asked the children to tell me their stories. I was happy to see them so enthusiastic about working the problems.

One day we even used the trays for English. First I picked up a pig from the 11 tray. I said, "I can make a sentence about this pig. 'The pig is fat.' Can you make one?" We all got to tell a sentence about the pig. Then we wrote our sentences, with a capital at the beginning and a period at the end. Then I gave each child an animal to tell about. Later each child could choose whatever he wanted from the trays to write about.

I'm sure that I will be using the trays in other ways as the needs arise. I found that the "real" things made the math easy and fun. I also believe that although in a sense the situations were contrived, the "contrived" experiences were real for the children, and enabled them to make discoveries on their own.

WHAT IS THE AREA OF YOUR LEAF?

Annemarie Garcia

I told my students that we were going to find the area of leaves today in class. I asked my new seventh graders, "What is area?" Some of the responses I received were: "Area is . . ." "Area is the distance around something." "Area is length times width." "Area is length times width times height."

These responses arose from things they remembered about area but no one really knew what finding the area of something meant. So then I drew a 3 by 4 rectangle on centimeter squared paper and someone told the area of the rectangle was 12, but still not 12 square centimeters. We counted the square centimeters and I finally received the response that the area of the rectangle was 12 square centimeters. We then found the area of a 4 by 4 square. They immediately gave the correct response--16 square centimeters.

Next, I told my students that I wanted them to find the area of the leaves they had brought to class. The looks of amazement when I had first made the suggestion were gone. One of the students said that he knew how we could find the area of each leaf. He said that we could trace the leaf on centimeter squared paper and start counting the squares inside the outline of the leaf. But what about the partial squares? The class was quiet for a few seconds and then one person said that we could try to fit the pieces together to make full squares. Of course! Everyone got busy!

THE LEARNING PROCESS

Jeanne Scropos

How do kids learn? The magus, guru, prophet and the Solomonic tomes don't have all the answers. You probably don't either, but with a little introspection, you might have a few more than you imagine. What turned you on to education? When did it begin? How did it begin? Mine was in elementary school. It was a long time ago, and a little ragged and unsophisticated, but it was exciting and I thought it could probably last forever. When I discovered that that was a myth, I had developed enough endurance to go the distance in other places.

It's doubtful that my teachers ever heard of Rousseau, Piaget, Montessori, Bruner or a hundred other educational sages, but conditions of school life at that time unknowingly touched on most of their theories. With minimal effort I can conjure up a picture of a small boy standing at the well, coatless and sleeveless amid the swirling snow yelling "'um body get the tea'her," around a tongue frozen solidly to the pump handle. The wind plucks the wail from the mouth of the boy and wafts it along to the teacher inside who grabs a pail, lunges down the basement stairs, draws water from the ancient furnace, and gallops like a knight to the rescue. We all vie for ringside seats at the cloakroom windows, but manage to get back to our seats, stick noses in books, and assume an air of minding our own business by the time the teacher returns the shivering, sheepish looking boy to the classroom. We always had good audio-visual material and it was a good day any day you weren't the star performer.

The school we were committed to for eight years had two rooms; a little room and a big room. One spent four years in each, barring failure. There was a cloakroom between the rooms and no pupil migration except for an emergency, errand running or presenting oneself for a spanking. Fortunately, this public punishment did not often occur. There were several rows of small wooden desks and a row of chairs in front of the teacher's desk for the reciting class. While one class recited, the rest of us studied or listened, depending upon how interesting the class at bat was. The sun always seemed to be shining from high up windows in the back, and we were warm and cozy and intimate. We were a family, joining and separating according to the need. The showoff was discouraged, the handicapped indulged, for such is the way with children when left to their own devices for establishing the rules for a functioning society.

Physical education was an all-inclusive activity. Art was a sometimes thing (mostly a pre-holiday treat). And music meant singing "America" in the morning and "Now we're glad to be going home" in the afternoon.

One day stands out which had an extremely menial beginning. It was a good day, indeed, for something exciting to happen. We had plodded a muddy mile and a half to school to sit a damp day surrounded by the rhythm of the rain beating on the windows. We had almost dried out when it was time to go home, and even though we knew we were in for it again, we were consoled by starting out dry. We booted and buckled and stomped our way out of the classroom just in time to catch the first act of Mr. Johnston Starts His Car.

Mr. Johnston, the big room teacher, had left his Model A sitting all day in the pouring rain, and although seemingly adequately equipped with a crank outside and a starter inside, neither proved sufficient to spark the moisture-laden motor. We were fascinated with the teacher's antics--crouching and cranking, then running around and flopping on the seat to wiggle the throttle violently, then back to the cranking again. When nothing happened, Mr. Johnston grabbed some newspapers from inside the car which he squashed into a sizable bundle, laid it on the hood of the car, then reached in his pocket, pulled forth a kitchen match, and calmly set fire to the bundle. We were goggle eyed and silent. A man who let his temper get away from him to this extent was certainly going to get a lot more respect from us in the future. Joining us on the porch, Mr. Johnston began lecturing us on moisture and condensation, and heat and evaporation. "The trouble is," he said, "it may blow up, so don't any of you go trying this until you get your own cars." Then he fixed us with a mean eye so we'd know he meant it. The fire burned out quickly, and we all cheered and applauded when the motor caught as Mr. Johnston gave it one last try.

On the way home we talked about what we had seen and about calculated risks. Our guesstimate was that we wouldn't have done it until somebody remembered that Mr. Johnston was riding while we were still a cold, wet mile from home, so we pondered relativity theories the rest of the way with water running down our necks and up through soggy boots.

Times have changed...conditions have changed....kids may have changed, but we have beautiful tenacity and an amazing faculty for reaching old destinations via new guidelines. How do kids learn? Don't you know? Don't you remember?

I HAVE ...

Judy Miles

Make a set of cards like those that follow. The cards are distributed such that all the cards are used. The person holding Card 1 starts by reading what is written on that card. The person holding the card that answers the problem then reads his/her card and so on. (It doesn't matter which card starts really. They are planned to work in a circle.)

A nice extension would be for the children to plan other decks of cards that work the same way.

1 I have 1. Who has 17 times as many?	2 I have 2. Who has 2 more?	3 I have 3 Who has this and a dozen more?	4 I have 4. Who has twice as many?
5 I have 5. Who has this and 5 more?	6 I have 6. Who has this minus 2, times 3, less 3?	7 I have 7. Who has 7 more?	8 I have 8. Who has 3 times as many?
9 I have 9. Who has this Divided by 3?	10 I have 10. Who has 3 less?	11 I have 11. Who has 1 more?	12 I have 12. Who has this and half as many more?
13 I have 13. Who has a dozen more?	14 I have 14. Who has double this?	15 I have 15. Who has this multiplied by 2, minus 11?	16 I have 16. Who has double this?

We then discussed the probability or chance of the number staying at 6 the next day. Since there are 4 possibilities the chance is 1 out of 4 or 25% that the Number will remain the same, 2 out of 4 or 50% that the Number will change to 5, and 25% that it will change to 4.

On the next day, Friday, the number was still 6. We discussed what had to have happened the night before. The discussion was getting better. The students were catching on. They were very enthusiastic.

The Cards and Phillies were each playing three games over the weekend. The possibilities and their probabilities became more interesting. The students put this chart on the board. (W for wins. L for losses.)

Cards	Phillies	Magic Number on Monday	Chance	
W 3	L 3	0	7%	1/16
W 3	L 2	1	12½%	2/16 or 1/8
W 2	L 3	1		
W 2	L 2	2		
W 3	L 1	2	19%	3/16
W 1	L 3	2		
W 3	L 0	3		
W 2	L 1	3	25%	4/16 or 1/4
W 1	L 2	3		
W 0	L 3	3		
W 2	L 0	4		
W 0	L 2	4	19%	3/16
W 1	L 1	4		
W 1	L 0	5		
W 0	L 1	5	12½%	1/8
W 0	L 0	6	7%	1/16

Questions I then asked were, "What are the chances the number will stay 6? go to 5? to 0? What will the Magic Number probably be on Monday according to the law of probability? What could happen to the teams to influence this law of chance?" (Players could get hurt or sick. Phillies play on home field and do better than when they're away. Cards play away and do lousy. No fans show up to cheer for players. Players have death of close friend or relative, etc. etc.)

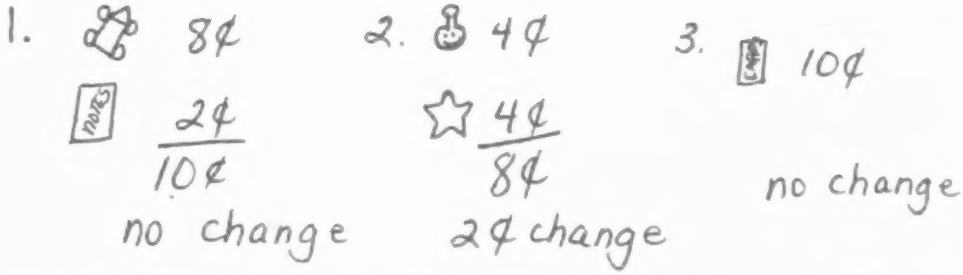
On Monday the Magic Number was 2. This was better than the 3 which was predicted according to the law of probability. The students gave reasons why the Cardinals did so well!!

Each day the class started and ended with a few minutes about the Magic Number. Parents told me their children were very enthused about this and had a new interest in the Cardinals.

COUNTRY STORE

Donna McBride

I recently purchased a large selection of very inexpensive toys for kids (from the MAPAC toy company). I placed a price on eight to ten items ranging from 2 cents to 10 cents and displayed them on the chalkboard. I then told the children they were able to come into my store three different times. Each time they came they were only to bring a dime. They had to "spend" the imaginary dime and wrote out their three purchases as problems (for example):



1. 8¢ 2¢ 10¢ no change

2. 4¢ ☆ 4¢ 8¢ 2¢ change

3. 10¢ no change

With each purchase, they were to let me know if there was any change involved. After three problems, I let each child choose one of their problems they liked best and take the awards from the treasure chest.

COMPUTERS IN EDUCATION

Judy Maxson

Children in our classrooms have been conditioned to be visual learners more than any generation of children in history. They have grown up with television--television as entertainment, as a babysitter, as a primary means to learn about their world. Mothers place infants in wind-up swings or playpens in front of the television set almost before their eyes can focus on anything other than the bright, rapidly changing colors. Toddlers can sing or recite commercial jingles before they can say their ABC's.

With the advent of home video games, television sets are being used in an increasing number of homes as interactive entertainment centers. And if a family does not have a home video unit, all a child has to do is go to the nearest grocery store or shopping center and be tall enough to deposit a quarter to play one of the many popular arcade games which have invaded almost every public place except schools and churches.

While it cannot be said that a large number of children have access to a home computer, a great many own or have access to computerized educational devices such as the Little Professor, Speak and Spell, Quiz Whiz, etc. They are also entertained by hand-held computer games like Simon, Merlin, computer baseball, football, basketball, car races and the like. This generation of children is geared and conditioned to look at a screen--large or small--push a button and be educated or entertained.

Not only are today's children accustomed to using and learning from some form of computerized instruction, they enjoy it. "Unlike television, the computer is a two-way communication system, one that requires interaction. Children enjoy and grow from such interaction, benefitting from the individual instruction and attention, and being able to work unselfconsciously at their own pace." (Hopmeir, 1981, p.36)

Children feel comfortable using computers because of the unlimited amount of patience and positive reinforcement they are able to provide. Ken Brumbauch, the director of the Minnesota Educational Consortium, is quoted in Newsweek as saying, "The computer is friendly, patient and non-violent. Guess what? Teachers are human--they get angry and they only tolerate so many questions per period." (Marbach et al, 1982, p. 52)

And computers are not just for high school students. The Lane Montessori School in Wynnewood, PA, is using personal computers with 20 toddlers from 15 months to two years of age. (Polin, ed., 1982, p. 99)

An article written by Stephen Kimmell in Creative Computing makes an interesting comparison between reading and computing. He points out that children who become good readers come from homes in which books and reading are highly valued. Parents show respect for books, read often, and begin reading to their children at an early age. In these homes reading begins as a close, sharing experience long before it is meaningful as a transmittal of ideas. His central question is, "How different is sitting on your father's lap listening to a book from sitting on your father's lap playing a computer game?"

"There are differences, and the most obvious one is that in one activity you are passive while in the other you are actively affecting the outcome. More important, however, are the similarities. You are warm, have a good feeling about yourself, your father, your book, and your computer." (Kimmell, 1981, p. 46) And the May 3 issue of Time magazine reports on Corey Schou, a computer scientist at the University of Central Florida in Orlando, who rigged up a home computer so his five-month-old daughter could operate it by pressing buttons in her crib and changing the designs on a nearby screen. He says, "Basically, it's an electronic kaleidoscope, another diversion, another learning device." (Golden, 1982, p. 56)

Among the reasons that educators like computers is the fact that computers can be utilized in the instructional process. The Time article previously referred to reports that there are approximately 100,000 computers in U.S. schools. These are being used in at least 15,000 of the nation's elementary and secondary schools. (Barger and Barger, 1982, p. 13) Minnesota's Educational Computing Consortium has purchased more than 5,000 personal computers for use in elementary and high schools around the state. (Marbach et al, 1982, p. 52) In Florida and Michigan, parent groups are holding bake sales and carnivals to buy computers for their children's schools. (Golden, 1982, p. 53) Computers have been purchased with federal funds, grants from industry and computer manufacturers, and may become even more readily available to schools if Congress passes a bill introduced by California Congressman Pete Stark and Missouri Senator John Danforth that would allow computer manufacturers to take a large tax writeoff for any machine they donate to elementary and high schools. Presently, full deductions are allowed only if computers are given to colleges and universities. (Golden, 1982, p. 53) In a 1981 article, Business Week projected 270,000 computers in schools by 1985. (July, 1981, p. 66)

Programs are available from computer companies, commercial textbook companies, educational publishing houses and are also teacher-developed. The Minnesota Consortium, for instance, is developing and selling its own educational programs. (Marbach et al, 1982, pp. 53-4) And there are more than 1100 commercial educational programs available for the APPLE computer alone (listed in Swift's 1982 Educational Software Directory).

Teachers are interested in using computers in the classroom. The results of a sample taken from more than 4000 responses to a survey conducted by Instructor magazine (May, 1982) indicated that 86% of the respondents expressed a high level of interest. Thirty-nine percent used computers for instruction. Fifty percent had taken computer courses on their own, mostly at colleges and universities. Thirty-eight percent said they had had an inservice course on computers.

Colleges and universities are offering courses in computers in education, and making an effort to at least introduce prospective teachers to computers. A comment in Classroom Computer News (July/August, 1981, p.54) reads as follows: "While most academics cry into their sherry over the lost halcyon days of high enrollments and generous resources, educational computing professors puzzle over where to put the new computers and how to provide hands-on sessions for standing-room-only classes. The educational computing market is bullish, and information is a prized commodity. Scores of universities and colleges now offer courses and programs in educational computing." The article then lists nine colleges and universities offering Master's, Doctorate, or specialist degrees in computing education. These include Columbia University Teacher's College, the Universities of Florida, Oregon and Illinois among others.

Robert and Josephine Barger, writing in the Educational Journal published by Eastern Illinois University School of Education (Vol XV, No. 2, Spring, 1982, pp. 11-13) sum up much of the rationale for using computers in the classroom:

> But what about the computer is education? Is the education computer here to stay? Consider this prediction by Alfred Bork (1979), a physics professor at the University of California at Irvine who has done pioneering work with educational computers. "By the year 2000 the major way of learning at all levels, and in almost all subject areas will be through the interactive use of computers!' The year 2000 is only 18 years away.

Modern educators accept the claims made by Pestalozzi, Dewey, Piaget and others that students learn by using a combination of thinking and doing. Computers are most efficient tools for helping students develop their intellectual skills. They require a response from the child at critical points in a program before the program can proceed. This ability to involve students is a major motivating factor. It appeals to the senses of sight, touch and sound. The graphics capabilities are most compelling, especially to already visually oriented children. And the computer is endlessly patient, accepting and personal. And computers are here, NOW!

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SUMMING IT UP

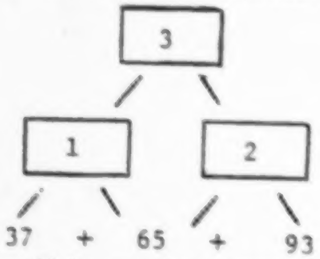
Diana Fuchs

As we all know, row after row of addition problems holds no great appeal for most of our students. They're tedious and monotonous for student and teacher alike. So let's put a little pizzazz in addition by changing the format. Who said addition problems had to be nice neat columns? Who said problems had to be written only in vertical rows? Try something different such as:

The Pyramid

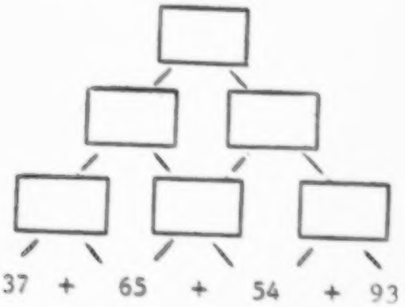
This simple shape may be used to help increase your students' addition skills. They think of it as a puzzle, which is fun and yet it provides practice and a bit of inquiry.

In simplest terms, the pyramid involves three or more numbers which are added in combinations in order to reach the peak.



The object is to follow the lines in order to fill in the boxes. For example, 37 plus 65 is the answer for box 1. 65 plus 93 is the answer for box 2, etc.

This may be increased either in size of numerals or number of addends.



Then, there is also:

The Magic Rectangle

This involves a series of vertical and horizontal additions which are further added in order to assure the student of his/her addition abilities.

37 + 26 + 84 $\boxed{4}$
36 + 19 + 15 $\boxed{5}$
7 + 8 + 49 $\boxed{6}$
21 + 3 + 56 $\boxed{7}$
$\boxed{1}$ $\boxed{2}$ $\boxed{3}$ ⑧

The object is to add each vertical row and place the answer in the box. Then add each horizontal row and place its answer in its box. The total of the vertical rows (1, 2, 3.) should equal the total of the horizontal rows (4, 5, 6, 7) and is written in the oval (8). This is a good way for students to check their own work.

Another way to increase student enthusiasm and/or involvement is to ask them to supply numerals for either of these shapes. Most teachers would be surprised how much more interest their students take in addition when it is their problem being solved.

PRAISE

Dennis O'Neill

A discussion I was on the fringes of went something like this (my interpretation): "Don't praise your students. If you're constantly telling them they did a good job, they'll never learn to work for themselves--for their own pleasure and well-being. They'll only work because someone's going to praise them. Besides, students can see through phony enthusiasm and it doesn't mean anything to them...."

In a short while the room began to bubble with excitement as though someone had lifted a weight from people's shoulders or placed an evangelistic hand on their heads and said: "Be healed, brothers and sisters!" The statements were met with overwhelming approval and left me with a kind of queasy feeling in my stomach. I wondered if I had missed the beginning of the conversation (although I had been listening the whole while) or had simply misunderstood (though the comments seemed straightforward). At any rate, it seemed reasonable to me to keep my mouth shut and my defensive emotions to myself, since I had not really given the subject a lot of thought. Since then, I have given it some thought and have done some reading and will share my thoughts with you.

The article, "Praise in the Classroom", written by Julia Hodges and published in SEEDBED 11, sparked the original conversation.

My first thought: Praise is necessary whether one is in the classroom, at home or any place else. Praise is necessary for you, me and our students. Praise is necessary.

My second thought: Thought number one should not mutually exclude the aforementioned discussion. (Congratulations. You've just met one of the world's great "middle-of-the-roaders.") Praising and not praising both have their places.

Praise has some pitfalls:

1. A positive comment may not fit the student's view of him/herself and may lead to confusion, frustration or anger. Each person has his/her own idea of what a good student is and which students fit that description. (S)he may feel (s)he cannot live up to the teacher's description of him/her.

2. In a classroom where praise is frequent, the absence of praise may be interpreted as disinterest or dislike ("If he didn't say he liked my work, then he must not like it").

3. Praise can embarrass some students, especially when the teacher makes a big deal out of putting them on display.

4. Students may grow to depend on praise and demand added attention for their work ("Teacher, look at my paper!"). Insincere praise sometimes follows.

I feel praise which is given in a proper manner, for appropriate reasons (i.e. behaviors), on a timely basis is supportive of the emotional growth of the individual. So, what is proper or appropriate praise?

The biggest difference between the proper and improper use of praise appears to be the ability of the person giving the praise to be specific. Too often, praise takes the form of: "You're such a good boy." What is your definition of a "good boy"--one who has for the first time this school year been able to sit in his seat for ten minutes without getting up and bothering others? Well, that is not my idea of a good boy, although that is certainly praiseworthy behavior.

Notice the distinction--praising accomplishments not personality. This sounds like a better approach to me: "Jimmy, you are doing a good job of staying in your seat today. I really appreciate it." This is realistic praise. It makes Jimmy aware of the teacher's good feelings toward his staying in his chair and it does not give him the impression that he is either a good or bad person for doing so. Albert Ellis' followers have a poster that reads something like this: "Just because I behave wormily, that doesn't mean I'm a worm." Application: sitting in a chair for ten minutes on one particular day when the teacher happened to notice has little or nothing to do with the intrinsic worth of that child. And most children know that, at least until we adults confuse them.

Some examples of praise:

Helpful praise: "Thanks for cleaning the blackboard. It was very helpful."
Unhelpful praise: "You're the best blackboard cleaner around."
Helpful praise: "That's a very lovely art project."
Unhelpful praise: "You're a very good artist."
Helpful praise: "Your short story was suspenseful and very interesting."
Unhelpful praise: "You are going to be a great writer some day."

The statements of helpful praise give an opinion dealing with a behavior. The statements of unhelpful praise make judgments which the student may not be able to live up to in all situations, thereby setting him/her up for failure. And that failure will be in regard to him/her as a person, not in regard to his/her behavior.

In summary, I'm still in favor of praise and I'm going to try to make my praising deal with accomplishments rather than personalities. I'm going to try to be more sincere and specific to each individual and I'm going to think before I praise.

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25 + 25 + 25 + 25 ...

Helen Miller

"The children in the kindergarten class are going to make paper chains as a Christmas decoration. There are 26 children in the class. Each child will need 25 strips of paper for his chain. How many strips of paper will the class need?"

As I was working in the hall of the school, busily cutting the construction paper into the necessary strips required for the paper chains, several children stopped to say hello and to ask me what I was doing. I mentioned that I needed to cut 25 strips of paper for each of the 26 children in the kindergarten class. Then I asked the observers if they could help me figure how many paper strips I would need to cut.

The time I had to prepare for the next class was very limited, so I continued cutting as I talked with the children. I then noticed that one of the girls had taken out a piece of notebook paper and with the help of several others was consciencicusly writing down some figures. As I paused to take more construction paper, I glanced at what she had written down. I was so intrigued by the method the children had devised to solve the problem that I completely forgot what I was supposed to do and I watched and listened to what the children were doing. The following is an account of the process that the group of children decided was a logical one to use to solve the problem:

> One of the children wrote the number 25 on her paper 26 times. The other children counted the "25's" to be sure that she had enough. She did have trouble remembering that the last number written had to be a 25. Several times she wrote the number 26, but corrected

it each time. In unison the children counted by 5's, starting at the top of the column. The recorder wrote the "0" in the one's place and put the digit 5 over the left-hand column. The children then began the count by saying, "5; 6,7; 8,9; 10,11; 12,13; 14,15; 16,17;" (until they reached 63,64 which they said was the correct answer). Their answer was 640. Each time a number was said the recorder tapped her pencil to represent the number verbalized.

There were four or five children who assisted in this computation. Another child who had been passing by hesitated a moment when he heard the conversation. He asked that I repeat the problem. His method was much different in relating to a process to solve the problem. He thought a moment and said that I would need 250 strips for 10 children. I asked how many I would need for 20 children which seemed to be something he was not able to handle without a paper and pencil, so he continued on his way.

The original group seemed to be satisfied with the effort they had put forth. I thanked them very much for helping me with my problem. My next question was directed to the set of four 25's. They said that 25 + 25 was 50; 50 + 50 was 100. I asked them if they could find the answer by finding all the sets of 4 (25's). They were not too sure that this would work.

As we were talking about this possibility, their teacher walked by and instructed them to go outside. I mentioned that they were helping me with a problem - a math problem. She elicited the information that these children were a poor choice of students - these were the worst math students in her class of fourth graders!!!

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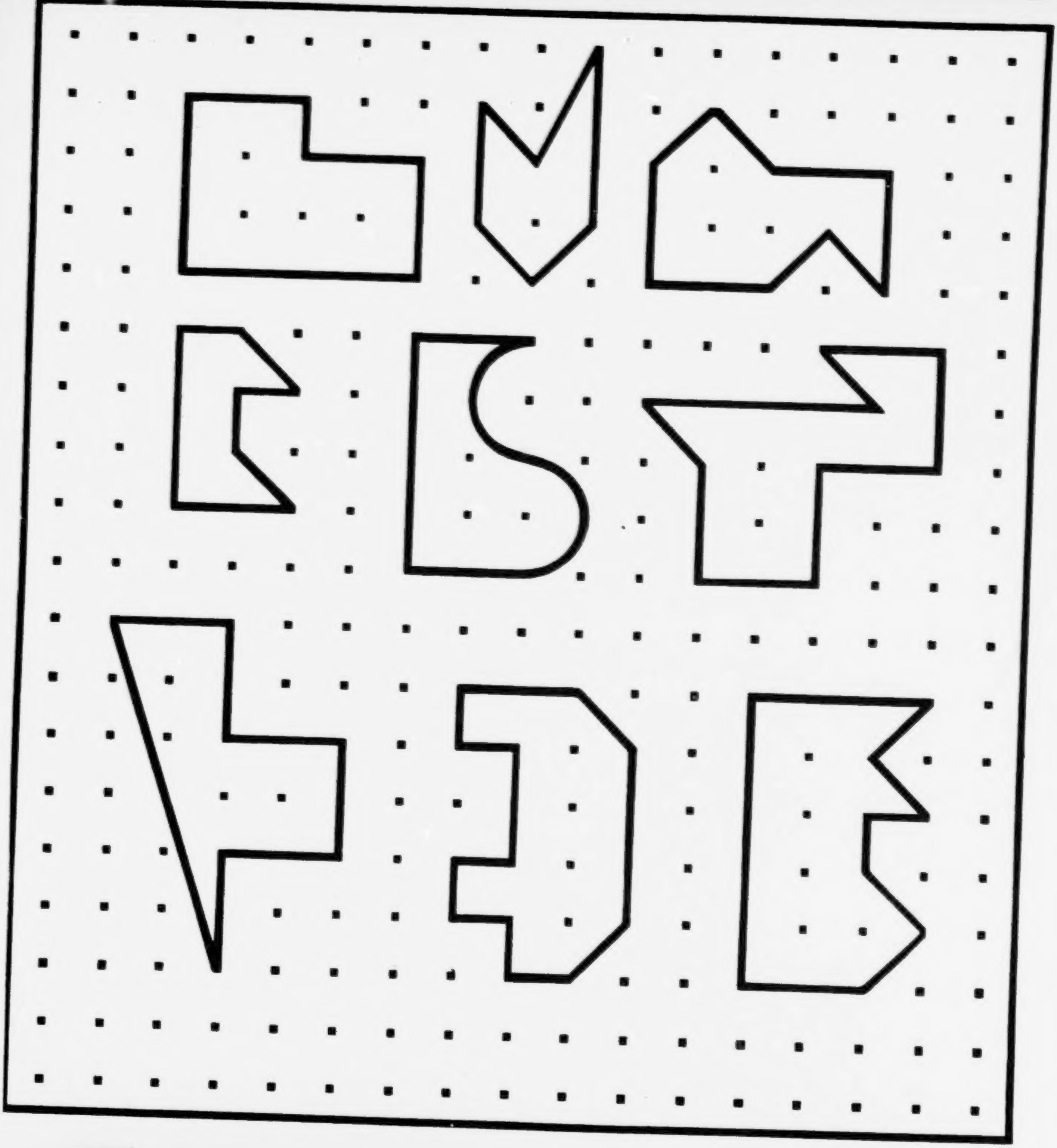

SEEDBED

SEEDBED

NUMBER 16

July, 1983

Teachers' Center Project

SIUE

Southern Illinois University
at Edwardsville

1546

Dear Friends of the Teachers' Center Project,

We're pleased to bring you SEEDBED 16. Sharing the good ideas of teachers and others interested in children and education is an exciting thing to do. But this issue of SEEDBED has been especially exciting to produce. We've been learning something new in much the same way a child learns. Earlier issues of SEEDBED were typed on an ordinary IBM typewriter. But SEEDBED 16 has been produced on a word processor. It's been an interesting experience.

In April, four Teachers' Center Project folks (Tom O'Brien, Mary Steffen, Helen Miller and Shirley Casey) attended the Association of Teachers of Mathematics (ATM) annual Easter course held at Bognor Regis, England - as rich an environment for learning as most of us have experienced - gifted people, interesting materials and adequate time, places and materials to make mathematics to the hearts' content! If you don't know the ATM journal Mathematics Teaching, you really must seek it out. (The cover design on SEEDBED 16 is one problem we brought back from ATM.) The problem was developed by Chris Hardman of Lynncroft Primary School, Notts., and calls the reader to divide each of the figures into two congruent halves. Try it - it's not a trivial problem.

Read the articles in SEEDBED 16 - try out the ideas you meet there. Share these ideas with your colleagues. We're sure they'll spark new ideas in you. Why not share those ideas with other Seedbed readers! Jot your ideas down and send them to us for possible inclusion in future SEEDBEDS.

Join us too in the idea that Knowledge is not a spectator sport!

Thomas C. O'Brien

Shirley A. Casey

Shirley A. Casey

23 June 1983
Edwardsville, Illinois

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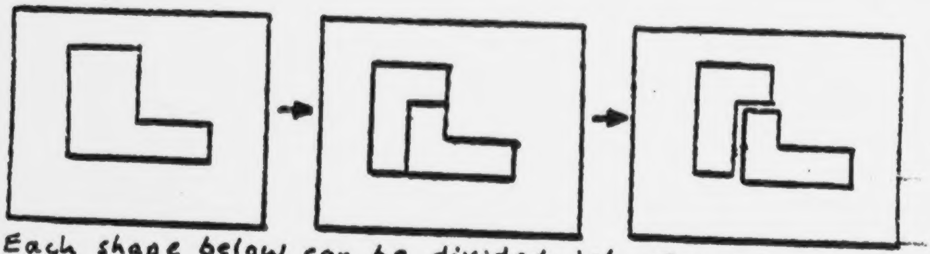
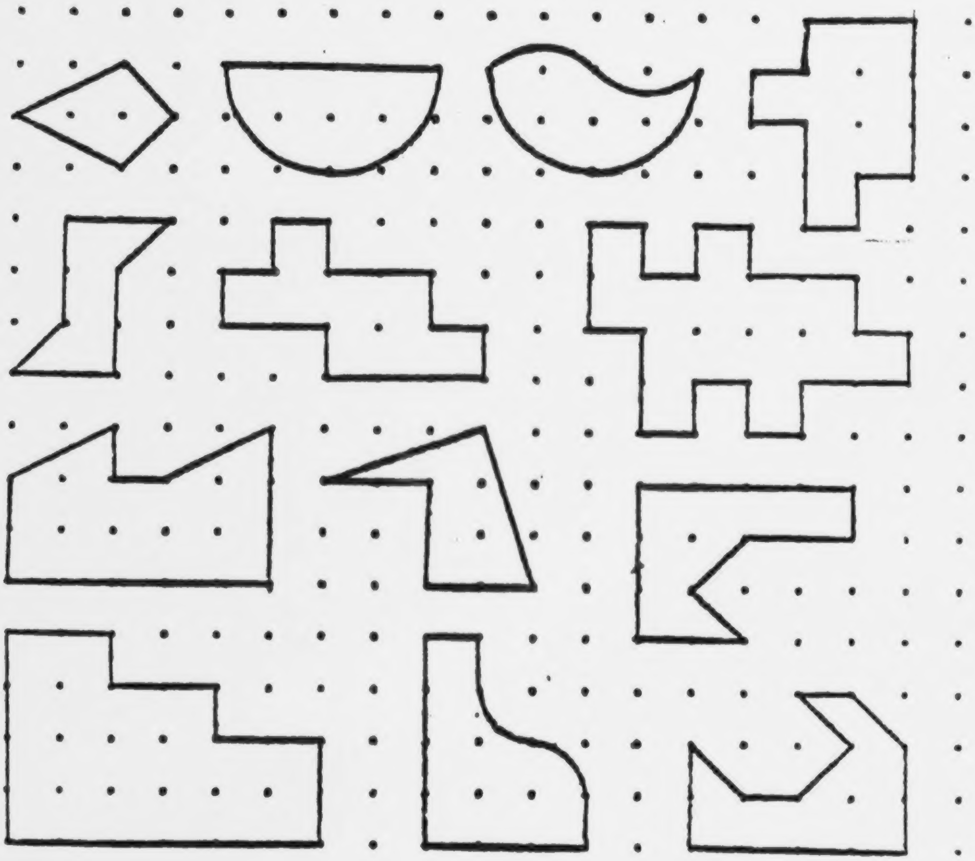
Congruent halves

Chris Hardman

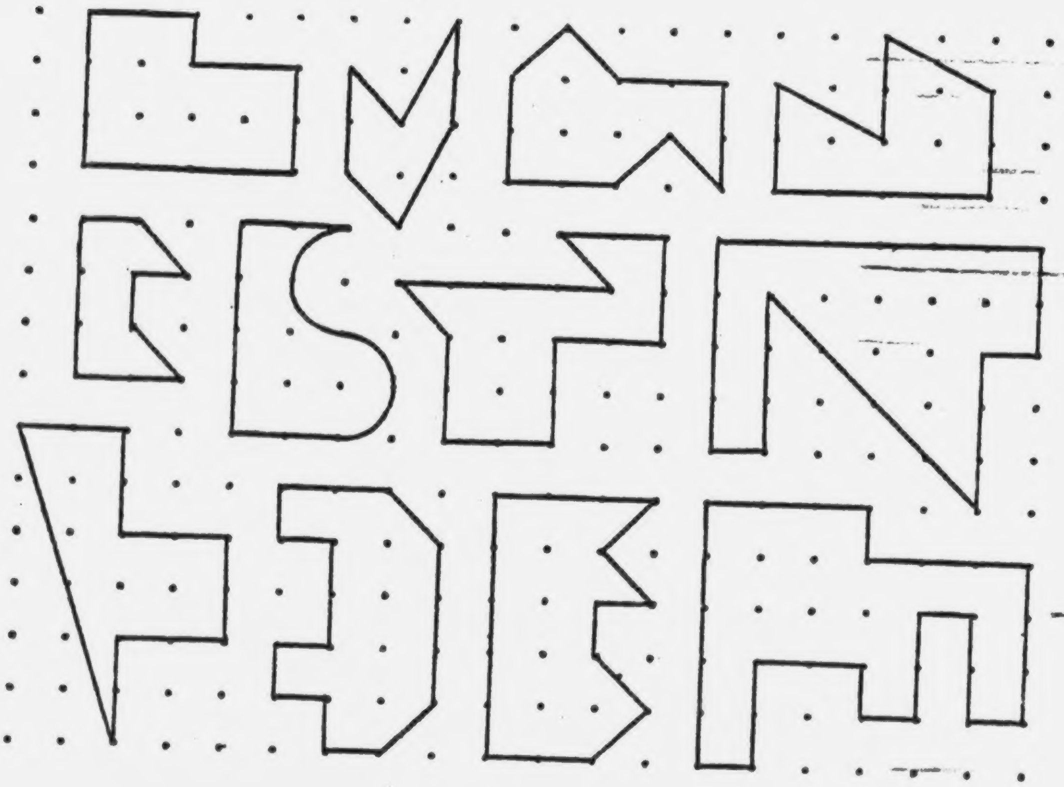


Each shape below can be divided into 2 congruent halves. You are allowed curves and mirror-images. To make this activity worthwhile, you must find a partner, take turns to explain possible solutions. These explanations must be only in words. No gestures allowed - hands in your lap. Try to justify solutions.

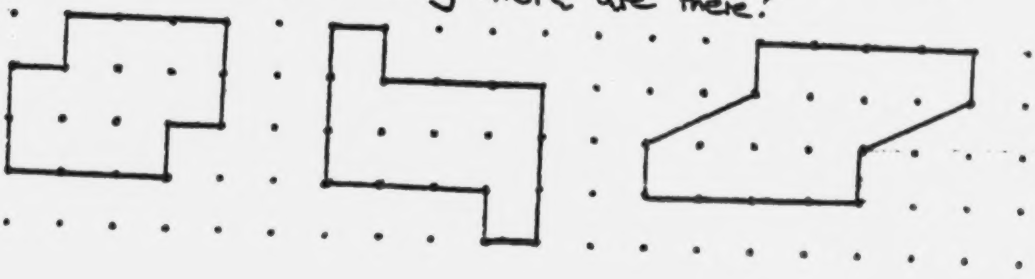


Congruent halves II

Try these harder examples



Try to find at least five different ways of dividing each of these shapes - do not use curves
- each line must begin and end at a dot
- how many more are there?



RECENT PIAGETIAN RESEARCH

Hermina deZwart Sinclair

O'Brien: I think that there are local people, such as the Mayor of St. Louis. And there are national people, such as Barry Commoner and Stan Musial. And I think that there are World People. Mimi Sinclair is a World Person. She is a distinguished Professor at the University of Geneva, a colleague of Jean Piaget, and a researcher on the intellectual development and the language development of children.

Sinclair: Thank you, Tom. The title of this talk should be "Preliminary Thoughts on a First Study of Hypothesis Making in Children." Let's call it "Hypothesis Making," okay?

Since the talk was originally announced as "Main Currents in Piagetian Research," I will try to put what I was going to talk about in the framework of that topic. This is a bit difficult because I don't know what you know about Piagetian research and Piagetian theory.

I suppose that most people think of Piaget's theory of development as a stage bound theory--that there are different stages in cognitive development which can loosely be characterized by various ways of functioning and that these stages correspond to the common sense stages that everybody sees in a child.

That is to say, there is the very first age period which goes to about age 1 1/2 or so. Then the child starts to talk and starts to behave in a more coherent way and becomes a pre-schooler. Then at 6 something new begins and at 12 something else new begins. The something new at the age of 12 is more or less the way of thinking that we have as adults; after that what is supposed to be new is merely more new information and better and more practical ways of dealing with problems but not a novel way of thinking.

These are more or less the steps Piaget defined and formalized in a certain algebraic way, but we needn´t be concerned about that. Certainly his first works and his writing for a long time were concerned with the idea that the child is not a miniature adult who merely lacks a certain number of things. It is not the case that he learns bit by bit and that all these bits get added to what he was born with. In fact there is some of that, but on the whole it is a total transformation that takes place from period to period. There are periods where the child is in equilibrium where nothing much is happening (where new information is taken in but no revolutionary change in the way of thinking takes place) and there are other times--such as around the age of 1 1/2 to 2, 5 to 7, and 11 to 13--where something profound is happening, where disequilibrium starts to happen and where something qualitatively new happens. The new way of thinking is not new in the sense that the child does away with everything he thought before. Rather, it´s more in the way that certain mathematical theories can be fitted, integrated, into new theories. Euclid is not thrown out of the window--we still think in Euclidean terms--but, he has been put into a much larger framework which gives geometry a different quality.

Now the newer line in this type of research is that now these structural periods have been well investigated it becomes possible to look more at the process, that´s to say the way children actually look at problems and deal with them across the stages. One can look at something like contradiction. How does a child deal with contradiction in the early ages and how does he deal with contradiction in the later ages? Or generalization, which is a process that goes on in babies, goes on in young children, goes on in adolescence. According to the structure of thought in the various big periods, generalization takes on different forms and different functions.

I think that all this is probably not very comprehensible unless one is really inside the theory, so I think the best thing I can do is give an example of work with Piagetian colleagues in Paris and with Genevan co-workers. We have been looking at the development of hypothesis making. I have a certain number of examples which I would like to tell you about. The earliest examples are from children who are 20-21 months old, very young babies indeed, then there are some examples from 5 year olds, then some from 8-9 year olds, and then from 13-15 year olds. Let´s see in what sense one can say that hypothesis making is already there at the very early ages and in what sense it has a different nature--is not the same approach to a problem--as hypothesis making is at the age of 14-15.

To make a long story short, in Paris with my colleagues Mira Stanbach and several others who work in a pedagogical setting, we have been looking at babies between the ages of 9 months and 24 months playing on the floor usually (and sometimes around a table) with certain collections of objects.

The situation I would like to talk to you about is a situation where the children have a rather odd collection of stuff. The odd collection is composed of materials that can easily be transformed--for example, some cotton wool, a string, an elastic. There are also things that are pierced--a big wooden ring, some wooden beads, and some beads made of paper mache. Also, some spaghetti (uncooked), two tubes open at both end, (the tubes cigars come in), and a couple of sticks.

A side issue of the situation is that we filmed the children longitudinally once a week--there are about 15 subjects that are filmed week after week--and there are two different situations, 1) where the child is alone and 2) where there are four of them together. Another side issue I just would like to mention is that now that I have seen this in a lengthy program my views on what in Paris are called "creches" (nurseries) for very young children have greatly changed. I think there is something babies under the age of two get out of being with peers which they do not get out of being inside the family. Perhaps at the end I could get back to that.

Back to hypothesis making. Given this collection of objects, and given the fact that the child can do what he likes with the objects (and all we do is film; there is no intervention. Of course, there is somebody behind the child in case the child starts swallowing stuff or hurts himself) all sorts of interesting things happen. The particular behavior I wanted to describe takes place when a child picks up one of the tubes I described. From the age of 14 months onward one of the most general activities of all babies is putting things into other things and exploring certain objects that are made to be containers as against others that seem to be made to be contents. Whenever there is a cup or a box you will see the 13-14 months old start putting things into that.

Now there is no box in our materials, but there are these pierced objects and by the time they are 14 months old they all start putting things through the pierced objects. Their behavior with tubes--this has been seen in quite a number of them and it struck us as something rather extraordinary--is to take up one of the tubes and take up a stick and first of all try to put them together as if they had two sticks and they make sure the two were something different. Then they put down the sticks and put their finger in one side of the tube and put their finger in the other side of the tube. (What they don´t do is what they do much later, beyond 3 years old. They don´t look through the tube to see if the whole thing is pierced. It seems to be sufficient to notice the two holes.) Thereupon a stick is taken up and put through the tube. The stick happens to be slightly longer than the tube, so it comes out a bit. It happens almost every time that when they are doing that they don´t hold the tube completely horizontal so the stick slides out and falls to the floor. Now this is a very interesting event to a baby. When it first happens, it surprises him. There are a certain number of behavior indications that tell us that this is a surprise. It´s a surprise in the right sense because it amuses him and he wants to reproduce it, so he picks up the stick again and holds his tube the same way, and puts it through again. Now before letting go he already looks underneath, where he knows it is going to come out. And he is very happy when it does. What we often see is children holding the tube in the same oblique way and pushing the stick through at least 6 or 7 times. Now this is a hypothesis on reality. Reality, if you make the conditions right, is going to reproduce itself. There is a certain regularity.

Things are--I don´t dare to say "lawful"--but they are regular. They don´t do just any old thing at random.

What is more interesting: after having established this regularity, the child will put his hand the other way around and with great trouble put a stick on the other side. Now he is looking for something before having seen it. He already knows, apparently, that the stick is going to come out the other side. So you´ve got what looks to us as the beginnings of experimentation in hypothesis making and physics. These words have to be used in quotes; the babies establish regularity by recognizing an interesting event and reproducing it. Then when they vary the conditions, they already have some anticipation of what the conditions are going to produce because when they turn their hand around they look this way (demonstates) instead of looking at the place they looked at first.

Another type of behavior at the same age seemed very important to us. This happened with sort of a grid--the kind of thing you would put a hot pot on--grid and holes. Often the child will put the paper beads into the grid when it lies on the table. Sometimes, when the whole thing gets displaced, they discover that if you lift up the grid the beads fall out because they´re smaller than the holes in the grid. This again is something very interesting to reproduce. Once or twice it happened that a child had put in one of the beads that were a bit too big, so when he lifted up the grid the bead didn´t fall out; it stuck. This is different. This was not treated as an interesting event. This was treated as a nuisance because the expectation was that everything should fall out. This was a bit of noise or something. However, the child started poking, and the beads still didn't come out and so he picked up a stick and poked some more and then it did come out. Now the astonishing fact was that immediately after that he again put the bead in (with the grid lying on the table) and lifted up the grid and once again it wouldn't come out. Now he knew what to do. Straightaway, he picked up the stick, poked at it, and it fell out. Now this picking up on a nuisance event and reproducing the nuisance seemed to us very important. Why reproduce an event that is interfering with your experimentation? There seems to be only one reason for that: to understand it and to make sure that if you can do it once you can do it twice or three or four times. It is important to get rid of what computer scientists call a bug. This was definitely a bug. All this, of course, is not yet hypothesis making the way we understand it in adults, yet it seems to have some of the same characteristics.

Another interesting point, was that it did not look as if the babies with the stick and the tube were trying to find out why this interesting event (the pencil sliding out of the tube) happened. At later ages you will see a child holding the tube horizontal, then little by little making it go more oblique and noticing when the stick comes out. These, of course, are interpretations but it looks as if there is some search for--should I say explanation? When does it come out? This at the same time is a search for why does it come out. None of the 20-24 months olds did that. Definitely their hypothesis making and experimentation was to have success, not to explain. They wanted to reproduce the interesting events but not to find out why they happen or exactly when they happen.

The next example,--I make a big step in ages--comes from about the age of 5. This experiment, done by Karmiloff and Inhelder in Geneva, is again very simple. There are a number of long blocks which can be balanced on a support. A number of the blocks are symmetrical, i.e. the weight is symmetrically distributed so if you put them in the middle they will balance. Some of the blocks, on the other hand, are weighted with a spot of metal stuck on one side so if you put them in the middle they won't balance. Now 2 1/2 to 3 to 3 1/2 year olds, if given an example and asked, "Can you make them balance?" just do it. They catch on straightway. They put the other blocks on the support with no trouble. They make all the blocks balance because they have their hands underneath and the (weighted) side that goes down they just push up until it is in the right place.

An interesting group is the 5 year olds. The 5 year olds look at the blocks and say, "I know about that. It should be in the middle." Some of them say, "I know all about that. It's like a see-saw." "It's like scales." "It should be in the middle." So they proceed to put the blocks on in the middle. Unfortunately, this works for certain blocks but not for others. When the weighted blocks are put on in the middle, of course, they go down and they don't balance. Now these children seem to have totally lost the trial and error approach of the younger ones. They say, "Those blocks, they can't balance. They are no good. I don't want them." And the adults say, "Well, wouldn't you like to try? It'll work," and the children say, "No. It should be in the middle. I pick it up, look and put it in the middle, look, and it doesn't balance. No good."

These children have a theory. That's different from just having ideas. They've got a theory and the theory is okay but the objects aren´t. And there is just no way for the children to get back to trial and error.

I won´t go on about this experiment too long but at later ages--at the age of 8 or 9 or so--they will be ready to start working on the blocks that were no good for the symmetric theory and they will go back to trial and error.

But perhaps you can see what I think is an important issue here: if you just deal in success on a test, the 3-4 year olds do much better in this particular situation. They can balance all the blocks. They succeed. The 5-6 year olds just don´t succeed. Obviously, it´s not because the 5-6 year olds are dumber or less developed than 3-4 year olds. It´s because the older child works on theories, something totally different from just trial and error. It isn´t stupid, by the way, not to want to let go of a theory. If we let go of our theories at the first sign of contradiction, we don´t get very far. The good idea is to stick to your theory to its limits and then to look at the exceptions. The exceptions are often very important.

The next two examples are probably the most interesting because they fall in the ages with which all of you are more familiar with. They have to do with a well known Piagetian task that has to do with volume conservation. Does everybody know about? Who does not know about conservation tasks? Nobody. Great. The conservation tasks give some mysterious results.

As you know, if you have the famous two clay balls and they are just the same--there is just as much clay in the one ball as in the other--and then you roll one into a sausage and ask a 6 year old if there is just as much clay in the sausage as in the ball, the 6 year old may still say, "No, there isn´t, because your sausage is longer so there is more clay in the sausage than in the ball." Or if you break one of the two original balls into little bits, the 6 year olds tend to say, "No, it is no longer the same amount of clay. Look at all those little bits. Look at the big ball. No, it couldn´t be the same." (This could happen at age 5, or 7, or 8; the ages are by no means fixed.)

A couple of months later they say, "Of course, it is the same because after all you didn´t take anything away and you didn´t add anything. Why should it be more or less? It looks very different--it´s longer but it´s thinner." You know these arguments.

Let me trot out my famous example to give you some feeling of why children think of non-conservation, which is a peculiar idea. If I have two raw eggs and they weigh the same, and if I boil one of them, will it weigh the same as the one I do not boil? There is no need to come up with an answer but I would like you to think about what is going on in you head. You are asking yourself questions. The answer is not obvious at all. Now this is the feeling a child has when you ask him the question about the amount of clay in a ball of clay. It has nothing to do with simply looking at the length of clay. There is something funny there for the child which for us isn´t funny when you just change the shape of something but which does become funny when you do things like boiling. You don´t feel very comfortable. You´d like to ask some questions. I am not going to answer the question, by the way. It doesn´t matter. But in all the questions on conservation the child has the feeling you had just now, this feeling of, "There are lots of things involved. What could it be? What's the main thing I have to think of?"

So we are at the point where the 6 year old on the question, "Is there still as much clay in the ball as in the sausage?" says, "Yes, sure, nothing was taken away and nothing added." Now ask the same child an hour later about the balls of clay, one of which was rolled into a sausage or broken into bits but ask the question in terms of weight. Do the two still weigh the same? The same child who said nothing taken away and nothing added when you ask him about the amount of clay will now say, "It doesn't weigh the same. All those little bits?" (Or that sausage?) No question. No way. It doesn't weigh the same." Now this is a bit mysterious because he only had to say the exact same thing he said in the first place to get the answer right. He is clearly already capable of thinking that there is just as much clay because you didn't add anything or take anything away, etc. Why doesn't he do that when you talk about weight?

Now go a step higher and take two balls and take two glasses of water and do the same thing--sausage or bits--but ask about the rise of the water level. First you put in the two clay balls and the child sees that the water level goes up to the same height. You take them out and you make one into a sausage (or bits) and you say, "Now if I put them into the water, will the water level go up to the same height?" The same child who gave the mature answer for the weight question will once again say, "Of course it doesn't rise to the same height. No question".

This was the age where I wanted to give an example of hypothesis making. You take 8-9 year olds who have no trouble with the weight question and you do it with the water jars. You use two clay balls, one of which is transformed. (Or you use metal cylinders made of different kinds of metal--same size, different weight. Or you use metal cylinders the same weight, different size--as you can see, you can play around with that.) Now these 8-9 year olds, as I said, will say that the clay balls do not displace the water to the same level. And then we put them into a sort of learning session and we actually put the transformed clay into the water or the child does it himself. Lo and behold, he sees that he is absolutely wrong, and says, "Oh, that is not right."

Now what do the 8-9 year olds do after quite a number of demonstrations of this kind? They start spouting hypotheses! They say, "Maybe some water got in when you made it into a sausage." "Maybe it is easier for the water to get in when there's little bits than when it's a round ball." "Maybe the one went down quicker than the other." "Maybe the ball presses heavier on the water than the other one" etc., etc. In fact, what their hypotheses come down to is that they think of density, they think of speed of falling, they think of pressure, they think of surface area. They think of a whole lot of things that are absolutely not stupid. It is simply that they are irrevelant in this particular situation. You can keep on as long as you like during these sessions and they keep on thinking of weight as the important factor for the determination of the water level.

As long as you have two objects that are different in weight they will say that they do not weigh the same so the water won't go up to the same level. And if they are shown that it does go up to the same level because they happen to be the same size they come up with all these explanations. Strangely enough, they are even capable of compensation. That is to say, if you have a heavy cylinder that is smaller than a lighter one--and they are shown all this before you start putting it in to the water--they will say, "Well look, maybe now it will go up the same." And you say, "Yes, how come?" "Because the bigger one is lighter and the smaller one is heavier, so it could well go up the same way." "The heavier one will make it go up higher and the bigger one will also make it go up higher."

Now an older child will never think that you can compensate for volume by weight or for weight by volume, but for these children this is a possibility. In a sense this means that they have already pulled apart weight and volume (weight and size, if you like to talk in children's terms) but their theory is clearly that weight influences the water level. You can add other hypotheses to that but you cannot change it. It is absolutely necessary that weight influences water level.

Now let's move up to the 10-12 year olds. (Again, the ages are not absolute.) For them the problem is as simple as anything. As far as the clay ball vs. the clay sausage or clay bits (or the clay pancake, another variation) goes, no problem. You didn't take anything away and you didn't add anything, so the water will go up to the same level. They won't even admit the necessity of checking. If you say, "Shall we look?", they say, "Well, if you want to, but there's no question about it." And they give the same answer for the cylinders of different weight. "It takes up the same room. Would you like to test it?" "No."

Now you go to the 13-15 year olds and once again you get the phenomenon of what psychologists are now calling U shaped curves. It looks as if these children regress because in a sense they start behaving like the 8-9 year olds. (It is a bit difficult because it gets mixed up with the children's school knowledge. You get a number of children who start out by saying, "Yes, I know all about that. It was some Greek scientist in a bathtub.") Then you start with two cylinders of the same size with one much heavier than the other and you get (in different terms because they are more sophisticated in their terminology) very much the same thing as the 8-9 year olds were saying. For example, "This one (the heavier cylinder) will make the water go up higher. It's heavier. The weight of the cylinder is a body. The heavier it is, the higher the water goes up. It exerts pressure on the water, you know. The heavier one exerts more pressure than the lighter one." This sounds exactly like what the 8-9 year olds had been saying. There's one difference. This child says that before any demonstration has taken place, whereas the 8-9 year olds come up with the idea after a few demonstrations where his theory has been contradicted.

Moreover, many children went on to say, "Come to think of it, I really think we have to look. I don't think I can just think about it and tell you. I think we have to try it out." So not only are their hypothetical ideas now possible to be verified but also these children know how to translate their ideas into an experimental situation. After having said that the heavier cylinder will make the water go up higher because it exerts more pressure, they say that the only way to know is to take two objects the same size and one heavier than the other and put them into the water. If it comes to the same level, we will know that the idea was wrong; if it indeed goes up higher with the heavier one, then I know my idea was right.

In the situation with the clay ball and the bits of clay, they will devise another situation. They say, "There are little bits of clay and it seeems to me that they might well stay suspended in the water. What would that do to the water level?" Then they say, "Well, let′s have a look. I′m going to make very, very little bits because if the water level still goes up as much with the tiny bits then I′m sure that breaking it up won′t matter."

So to get back and to make a long story very short, the 8-9 year olds have the idea of weight and they will not let go of the idea. When the weight theory is contradicted, they add some other ideas such as pressure, permeability, etc., to account for the contradictions but that doesn′t make them cancel out the weight theory idea. They cannot say in this situation that weight is irrelevant. Weight is relevant. It might be modified by some other factors, but these other ideas only come up after contradiction and do not lead to the child′s inventing a situation where the idea could be checked.

The 10-12 year old approaches the problem as if it weren′t really a physical problem but as if it were a logical problem. He just says, "You didn′t take anything away and you didn′t add anything, so we don′t even need to look." He doesn′t even think of the fact that between water and the solid there might be some funny things going on. (If it weren′t water but alcohol, even adults might not be so sure.) But the 10-12 year old won′t think of that. He will solve the problem logically; nothing taken away and nothing added, so everything is the same.

The 13-15 year old has not lost this capacity, but he had acquired such a sure way of organizing his world in a logically coherent way that now he is quite ready to think of the funny things that can happen in chemistry and physics. He is also quite ready to look at his theory. His theory is no longer something that merely leads to prediction, as it was with the tiny babies and with the 6 year olds and with the 8-9 year olds. With them the theory leads you to predictions. If some of them are right, you just forget about all the rest. You can never go back on your theory.

At the age of 8 or 9 in these examples you can add other hypotheses to explain the contradictions to your theory. But it seems to be only in adolescence that the theory itself can be seen as a collection of hypotheses and that the assumptions behind the theory can be questioned and that the theory is subject to verification. Moreover, the adolescent now knows how to set up a verification situation. And finally, the evidence of this verification situation is conclusive.

A short question and answer session followed Mimi´s address. The transcription of that session has been edited locally - we believe that we have stayed with the essence of Mimi´s answers. But it is possible that in our editing, we have strayed from the answers as they once existed in Mimi´s mind.

Question: Earlier you said that your research said something about the value of nursery schools. Can you comment further on that?

Sinclair: Would you like me to come back to that? Let me take an example which I find quite extraordinary. The children are a little bit younger than the ones I was talking about with the tubes.

They are about 18 months. There are four children sitting around the table. One picks up the big wooden ring and starts to put his finger through the ring. Body parts are often the first thing used to create a relation. Then he picks up a stick and puts it through the ring. Now next to him there is sitting another child, same age -- 18-19 months or so, who happens to be playing around with play-dough. He´s just mushing it around in his hands and he´s looking at the first child. Then he looks at the material on the table. There is no other wooden ring, but there is another stick. He picks up the stick and looks around. Now what does he start to do? (It took us a long time to see this. We looked at that film I don´t know how many times.) He puts his play dough in sort of a ball and he starts poking a hole in the play-dough with the stick. He goes on poking from time to time and looking at the other child poking until he has pierced the play-dough.

A third child has a rather big elastic around his arm. He observes the other two and takes the elastic off his arm and puts it around the spokes that stick up on the chair. Then he takes it off and puts the elastic around a small bead on the table. He lifts out the bead and then puts the bead down in the elastic ring again. The fourth is doing something similar. He´s holding some string and makes a loop and looks through it.

All of them, in fact are exploring the double relationship of container and contained. One has the stick and the ring, the second a ball of clay and a stick, the third an elastic and a bead, and the fourth had just a bit of string.

Now this seemed to us to be really quite extraordinary but now looking back at the films we find more and more instances of the same thing. That the second child imitated is quite clear. He couldn't do it exactly like the first child because there was only one big wooden ring, so he had in fact to produce something--a pierced ball of play-dough--to reproduce the same relationship. The third child again did it with different material and again reproduced this very abstract relationship of a pierced object being something you can put something through but also something that goes around other things.

Now this gives us a totally different view on what imitation is all about. It is not doing the same thing with the same material though it often starts off like that. I imagine that in the home a child would be given the ring, and thus the opportunity for him to go further to abstract something would not have been there so easily. It is this communal construction of things--this imitation which is not imitation in a direct way but reproduction of something that is interesting--I found it really extraordinary. It is not something that's so likely to take place in the home where the child is alone with his mother.

Question: How does a Piaget-oriented teacher differ from other teachers?

Sinclair: Let's consider two groups of teachers--one is up on Piaget and the other group is their clone in everything but knowledge of Piaget. Let's observe them. What differences would you hypothesize in their classrooms? How would one group of teachers be different from the other if the only difference in them was a pretty good knowledge of Piaget? It goes back to what we were saying about all this being rather close to common sense folk lore but common sense folk lore looked at from a very deep scientific point of view. Piaget's theory lends itself to an application which is totally wrong if you observe the theory in a very superficial way. It's like the 1 year old talking about the Greek who found out about volume but still thinks that weight is the most important thing. Piaget has shown tha something important goes on with children at the age of 6 and that's conservation of number and other things. So teachers with superficia knowledge of Piaget decide they're going to teach the children conservation of number and they're going to teach it right, whereupon we can now teach addition and there will be no problem any more. Now that obviously is not a Piagetian view that can be put directly into education but unfortunately I think that's what's done quite often.

Let me answer the question in 10 seconds. The Piaget-oriented teacher would view knowledge as a construction by children. The other teachers would view knowledge as a thing to be handed to this passive urn called a child. I think there is a world of difference between those two points of view.

The difficulty I suppose is that teachers are not there just to observe how the child develops. That's not their role. When hy children were young I wouldn't have wanted them to have teachers like that. They're there to help them learn. One of the problems that shows rather clearly from research on process learning is that there are moments when a child is ready to be shown something such as a contradiction to his ideas and where the contradiction will be observed and worked on and admitted as something that can bring him to a better idea. But there are other moments where a contradiction is just completely beside the point for the child. Now I think that having a theory - even a contradiction proof theory such as the 5-6 year olds had in that particular experiment is a very good thing. one shouldn´t try to undo that kind of thing. Just as it´s very clear that 20 month old babies look for regularity, look for something to hang on to, look for signs that the world is organizable, know that things will reproduce themselves if you help them along a bit--so the 6 year old has to hang onto his ideas about the world and how to organize it. There are no moments where the child is strong enough to say, "Now look! These blocks are no good! They will never balance." But it´s also very easy to destroy the feeling that you can dominate the world by thinking about it and having theories about it. If all the time you are shown contradictions to your theories there will very soon come a moment when you will say, "Look, the whole thing is just a mystery. So what! I give up trying! I´ll just learn a few things by heart and with that I´ll get along. That´s it! It´s incomprehensible. I don´t understand anything about it anymore."

Now I suppose that to the teacher a difficult task is to know when it´s OK to give certain bits of information to the child, bits that will really make the child go a step farther. It´s also difficult to analyze how a task fits into the total school curriculum in terms of more general concepts. For instance I couldn´t explain if asked what the basic construction that links together long division and decimals and fractions is. I know there must be something and maybe given a lot of time I could work it out. At the moment for me they´re just tricks I know how to do. I know how to deal with fractions. I know how to deal with long division. I know how to make decimals. But I don´t know the structure they must have in common.

What's the glue that holds them together? What's the nature of the concepts that one must be able to undderstand in order to view the three things as being different manifestations of the same concept? A teacher must know these things as well as something about child development.

Excerpts from Education and the Cult of Efficiency

Stephanie Garcia

The industrial revolution in the late nineteenth century had a tremendous but painful influence on American public schools. The following are quotations taken from Raymond Callahan's Education and the Cult of Efficiency . The quotations will show how the educators in the 1900's were more concerned with the operation of the schools than with the education of their children.

"The management of school affairs is a large business involving in a city of 100,000 inhabitants an expenditure of probably $500,000 annually; the same business principles adopted in modern industry should be employed here."

The problem of classroom management is primarily a 'problem of economy': it seeks to determine in what manner the working unit of the school plant may be made to return the largest dividend upon the material investment of time, energy, and money..."

"We are living in a practical, money making age...the big thing today is the reward, the dollar, and it is paid for practice and not for the theory and training behind the practice."

"If we can find out how many children begin school each year we can compute how many remain to the final elementary grade. Such a factor would show the relationship of the finished product to the raw material."

"The real educational leaders of the age whose influence will be permanent are those who have the business capacity to appreciate and comprehend the business problems which are always a part of the educational system."

"Now it is evident that if the number of years lost by slow children in a school system were equalled by the number of years gained by those making rapid progress, the money expenditure would be just the same as though every child were regularly promoted every year."

A motto of a school board--"to get a dollar's worth of service for every dollar expended."

"The school is a factory. The child is the raw material. The finished product is the child who graduates. We have not yet learned how to manufacture this product economically..."

"One issue, and only one, ran through the ten years of my Newton superintendency. That issue was the total cost of maintaining the school system." And as "the cost issue grew more intense, the subject of education in relation to cost became the dominant theme of my annual reports."

Speaking on measuring attitudes, "It would be difficult, but when we learn of the marvelous results achieved in some material industries through the elimination of waste motions, we are somewhat reassured." So far as education was concerned it was "rather backward compared to industry..."

"...education is a shaping process as much as is the manufacture of steel rails."

"...educators had come to see that it is possible to set up definite standards for the various educational products. The ability to add at a speed of 65 combinations per minute, with an accuracy of 94 per cent is as definite a specification as can be set up for any aspect of the work of a steel plant."

"...the results of a few well-planned tests would carry more weight with the business man and the parent than all the psychology in the world."

"The specifications for manufacturing come from the demands of the twentieth century civilizations, and it is the business of the school to build its pupils according to the specifications laid down."

"The lesson of the business world, from which we have much to learn in the matter of efficiency, is that detailed records more than pay for their cost and that an accurate knowledge as to manufacturing processes is impossible without such records."

Scientific Management contained a "message" for every teacher. "...if teachers did not voluntarily take steps to increase their efficiency the business world would force them to do so..."

"The system is similar to that in use in factory and commercial establishments and offers a method of determining where the city's money is being invested to best advantage, and where the results are not commensurate with the expenditures."

Callahan, Raymond E. Education and the Cult of Efficiency, Chicago: The University of Chicago Press, 1962.

NEW STUDY FINDS LACK OF CREATIVITY

Fred M. Hechinger

The curriculum is "sterile". Topics of great human interest "on the way to the classroom are apparently transformed and homogenized into something of limited appeal." Students "scarcely ever speculate on meanings" or discuss "alternative interpretations." Teachers "teach as they were taught" years ago in their own schooling. All th messages received by them "conspire to reinforce the status quo. The cards are stacked against innovation."

These are not observations on a single dismal school; they are conclusions gleaned from a summary report by John I. Goodlad, dean of the Graduate School of Education at the University of California at Los Angeles, in a seven-year study of American schooling. The study, considered one of the most extensive critiques of contemporary public education, dispatched teams of researchers into 1,016 classrooms in elementary, junior high and high schools. In addition, it collected curriculum information and samples of textbooks and other teaching materials from all 50 states and the districts in which the schools examined are located. The resulting book, "A Place Called School," will be published by McGraw-Hill later this year.

If the improvement of schools so much talked about and so widely desired simply continues on its present course, Mr. Goodlad warns in his report in the March issue of "Kappan," a magazine for professiona educators, the schools will remain very much as they are.

He complains of a "sameness" of instruction, with teachers doing virtually all the talking. He found that, on the average, only seven of 150 minutes of instruction in the course of a school day involved teachers' responses to individual students. Feedback and guidance to help students understand and correct their mistakes were often "almost nonexistent."

Few activities, Mr. Goodlad reports, called for, or even permitted planning by students.

The fact that social studies, which ought to spark a great deal of excitement, actually rated at or near the bottom of the list of interest, Mr. Goodlad said, "must give us pause. Why this sterility?"

One major reason, he believes, is that while a great deal is expected of the schools, from teaching the fundamentals to creating civilized adults, "whether schools are satisfying places for the students who attend them is largely irrelevant or of only passing concern." The message teachers get from outside the school is "back-to-basics and more discipline," a message that does little to stimulate imaginative planning by teachers and leaves even less room for change. Most teachers, in their training, read about some of the more interesting alternative ways of teaching, such as those advocated by John Dewey and by other reformers since his time; but Mr. Goodlad found that in their classrooms teachers have little or no opportunity to test such ideas.

This means that for most students school is a place in which to listen, to respond occasionally when called on, to read short sections of textbooks and write short responses to questions on quizzes. Students rarely, Mr. Goodlad found, read or wrote anything of some length. Most of the time, they listened or worked alone.

The same, he added, is also true of most teachers. Many of the 1,350 teachers in the study's sample appeared not to be working together on problems of importance to their own schools. Nor did they meet with teachers from other schools, inside or outside their districts, to deal with matters of common interest. When efforts wer made to help them improve their teaching, they usually attended short-term or even one-shot courses, initiated by the district or the county, often imposed by outside consultants.

"My mouth waters over the ways the money spent could be put to better use," Mr. Goodlad days. He considers it ironic that while every statement of goals for schooling, whether it comes from the state, from legislative committees, or from groups of educators or parents tends to be broad and far-ranging, all the practice in school and classroom is geared to keeping things as they are. Teachers ofte "run a serious risk of censure" if they try to break out of the mold.

"The policy makers are attuned to statistics, the business community, the state of higher education - to the larger political scene," Mr. Goodlad says.

Since teachers are sensitive to pressures imposed by state and district testing programs, "they get the message. The other messages - that there are goals beyond those that the tests measure...and that education means the deliberate, long-term cultivation of knowing, traits of character, and human sensibilities - are faint to begin with, and they are drowned out by the more immediate and stronger message," which is not to rock the boat.

Yet while the researchers found that changes mandated from the top down are generally ineffective, school management is rigged in a way that practically insures that changes always are imposed on teachers by higher outside authority. "Presumably," Mr. Goodlad says, "persons in Federal, state and local education offices are there to d something. Not having schools to run, their attention tends to turn to giving direction to those who do."

Fortunately, he adds, Americans are slowly coming to realize that much that has guided their economic development, land use and management is anachronistic - and so is the management of the schools. "Bits and pieces" of the kinds of theories and practices that might bring about the necessary changes to renew the public schools are "knocking about" in the literature and in many educators' minds, Mr. Goodlad says. How to translate them into action will be the subject of a subsequent report.

This article appeared in the New York Times on March 29, 1983. Reprinted by permission of the New York Times Company

PLOT FOUR

Brenda Wolf

The basic ingredient of Plot Four is a gameboard - a 12 x 12 grid divided into quadrants by vertical and horizontal axes. Mark the intersection of the axes with a zero, and number the other axis/grid-line intersections from 1 to 6 -- positive numbers above and to the right of the zero; negative numbers below and to the left of the zero. When the board is complete, laminate it for durability.

Other game equipment includes two sets of dice in two different colors (one set for positive numbers and one for negative numbers) and markers for each of two players (two different kinds of dried beans work well). You may also want to provide a dice cup, which you can make yourself by covering a small juice can with felt.

To begin play, both players roll one positive die and one negative die. Each set of numbers is added together, and the player whose total is closer to zero starts. The starting player then rolls the two sets of dice, chooses any two of the four numbers to plot, and places a marker at the appropriate coordinate point on the board. (Players may pick which die comes first in the coordinate pair). The second player follows the same procedure. The goal is to "take" four points in a row in any direction.

As the board fills with markers, a player may be unable to work out a combination of numbers that correlates to an open intersection. When that happens, the turn is lost. If a stalemate is reached before either player has achieved four in a row, the player with the greater number of markers on the board wins.

You may wish to introduce the game by having the players operate in the positive quadrant only, using just one set of dice and aiming for only three points in a row. Either way they play, students will get some positive point-plotting practice.

Idea by: Marianne Armstrong, Thomas Paine School, Urbana, IL

PAY THE PIPER

Lisa Quick

Materials:

2 number cubes labeled 4 through 9 and 1 through 6; 18 markers per player

Procedure:

Player A rolls the cubes, finds the sum of the two numbers shown on the cubes, then pays Player B that number of markers.

Player B then rolls the cubes, finds the sum, and pays Player A that number of markers.

The game goes on in the same way until one player is out of markers or until each player has had 10 turns.

The player with the most markers at the end of the game is the winner.

Game adapted from Mathematics in Our World, Robert E. Eicholz

CLASSIFICATION ACTIVITIES FOR CHILDREN

Thomas C. O'Brien

Here are three sets of activities for classroom use. The activities are easily "bent" to fit your class by changing the words. Make these activities your own by trying them and altering them as necessary.

1. Word Guess. The following words are written on individual slips. (There is nothing sacred about this particular list; make your own and have children make up their lists.) A player takes one of the slips, reads it, and tries to communicate the word to a second player (or to a small group of players). There are two ways to play the game: 1) only gestures but no pointing are allowed; 2) only words but no gestures or pointing are allowed. Here's the list:

star shoe hair ear talk melon dog rabbit monster carrot hear snow president color garden diamond light table refrigerator faucet driveway carpet friend cousin walk buy snowshoe angry patient bat boss basket help snake tired

2. Words in a Basket. Here are a number of baskets (i.e. categories). Players play in the round in groups of four or five. One player reads the basket (category) to the group and each player, in turn, puts something in the basket (that is, names something that fits in the basket). For example, suppose the basket is "Things that are round." Play could go like this: ball - world - hoop - ring - earth - circle.

The object is to continue as long as possible. There are no winners and no losers. Rather, players play as a team against themselves. Each time they must set a target. For example, they might agree to put six things in the first basket, as above, and when they're done they choose a new basket and a new target (try for ten this time). Here are some possible categories:

Things associated with Christmas
Things that are hot
Things that are red
Things that make noise
Things that fly
Things that are round
Things that are flat
Things you wear
Things in a closet
Things in a car
Things in outer space

3. The Umbrella Game. Here one player is given an umbrella (i.e. a category). He names things which belong under the umbrella and the rest of the group (a group of 4-5) work together to figure out what the umbrella is. For example, suppose the umbrella is "Things that are hot." The umbrella holder might give these clues: stove, frying pan, St. Louis in the summer, a burning match. The umbrella holder can give as many clues as are needed, but he cannot use the key word ("hot", in the example above) in his description. All the categories from Words in a Basket (above, 2) can be used. Here are some additional umbrellas:

Things you take on a trip
Things found in a pocketbook (purse)
Things that get lost

Things in a living room

Things associated with birthdays

Things that hurt your hand

Things you kick

Things you use to write with

Things that go on a dinner table

Things that get polished

Things that you give

Things that work with electricity

Things that water touches

Things that are greasy

Things that are flat

People who play baseball

People who appear on TV

Holidays

SYMMETRY

Norma J. Schroeder

How about classifying letters according to horizontal and vertical symmetry? Those letters that aren´t symmetric go onto a list of "no use, not now" letters. My students called them the "garbage letters".

Examples:

B O K   Y O U

Some students made a list of letters which fell in both categories.

After classifying the letters into lists, the next step is forming words. Then, have the students change one symmetric word to another. For example:

BOB to BIB   MAY to MAT   BOB to SOB

At this point, students may see some words can also be divided through the middle of the word, such as WOW or TOOT--that is, words themselves can by symmetric.

After extensive word play, the students may be ready to form sentences or verses. To further extend the lesson, they can write letters, using all horizontal or vertical words or both.

H
O
W
DID
Y
O
U

DO

T

H

A

T

?

BOB

We went further in the study of symmetry in order to see other objects than letters. Art is a good place to do this. For example:

Color one side of the letter very dark with crayon, fold the paper and press hard with an object, rubbing over and over the folded page. An exact replica of what was colored will be produced on the other side of the fold. "Blottos" can be made in the same way using water colors or tempera paints.

A lesson on symmetry can be made so much richer by extending into many curricular areas. Displaying the children's work can be a real spark for conversation and for extending other children's work.

TEACHING MATHEMATICS IN MIXED ABILITY GROUPS

David Lingard

The original suggestion for the title of this panel was: "Mixed Ability Classes in Mathematics: Problems and how to cope with them." "What are the most crucial problems associated with mixed ability classes in mathematics?", the panel desciption asked.

I was not happy with this title. It seemed to present mixed ability teaching in a rather negative manner. I felt that I wanted to be more positive and cheerful.

However, it is with the problems that I wish to begin.

I have been teaching mathematics to mixed ability groups of 11-16 year olds now for eleven years, in three comprehensive schools, and over this period I have gradually been drawn to the following conclusion:

There are *no* problems in teaching mixed ability groups but there are *a lot* of problems in teaching mathematics. To put it another way, problems associated with teaching mixed ability groups are *solely* problems of teaching mathematics.

What has happened is that teaching the full range of ability within one class has made some of the problems of teaching mathematics more apparent. Certain difficulties have been highlighted and consequently teachers working in this way have focussed their attention on them.

For some teachers it has made them aware of problems whose existence they were previously unaware of.

I would suggest three particular reasons as to how this has come about. Teaching mixed ability classes,

1. teachers have been required to pay close attention to individual children,
2. teachers have found it necessary to re-examine their aims and objectives in teaching mathematics, and
3. teaching all abilities has encouraged teachers to offer a wider mathematical experience to all children.

The growth and development of mixed ability teaching over the last 15 years has served a most useful function. It has acted as a means of diagnosis for many of the problems relating to the teaching of mathematics. Of course, it has not necessarily always provided a therapy!

Some teachers, faced with the problems that they felt were presented by mixed ability teaching have retreated to previous practice hoping, or falsely assuming, that the problems would no longer be with them.

Mixed ability teaching has brought its own advantages in addition to this valuable diagnosis. The advantages are numerous and have been well documented by me and many others, including, for example, in the Schools Council report published in 1977. (1)

For the moment, perhaps I could just reiterate what, for me, are two of the major advantages:

1. Raising student motivation, mainly through countering teacher expectation of pupil performance--an end to the premature and mistaken ʻlabelling' of children.

2. Raising academic standards for all, but in particular for

the most able . Previously these students were so often unwittingly held back by teachers imposing a ceiling on their performance - related to what the teacher thought a child should be able to do in the fourth year or the top set of the exam group.

But perhaps in the long term, as far as mathematical education is concerned, the greatest single asset and advantage to stem from mixed ability teaching will be the focus that it has brought to some of the very many complex problems of teaching mathematics.

I would like to expand upon the general point that I have made and try to illustrate it from my own experience and that of many colleagues.

The problems of teaching mathematics to mixed ability classes are not problems about suitable classrooms, adequate resources, reprographic facilities, computerised learning programmes, lack of suitable text-books, methods of assessment etc., etc....

They are related to 3 things:

1. The teacher's view of what mathematics is.
2. As a consequence of (1), the teacher's view about the ways mathematics can be taught and learned.
3. And the teacher's attitude towards children and their respect for children's mathematics.

Those who have taken up mixed ability teaching at secondary level have been forced (consciously or otherwise) to face these 3 issues. Those who have survived the challenge (and in the preceeding talk Denis Kennedy has clearly illustrated some of the problems for teachers in doing so) have come to know that teaching mixed ability classes is not the issue. The issue is teaching mathematics.

Let me take these 3 points in turn and look at their implications for teaching.

1. What is mathematics?

It is more than a body of knowledge, a bundle of facts and techniques.

A lot has rightly been said and written in recent years about mathematising and about humanising mathematics. (2)

Mathematics is an activity. It deals with skills and processes and ideas. It is something experienced and developed by each individual.

The implications for school mathematics teaching here are considerable:

Certain topics and pieces of mathematics are not sacrosanct.

Content is not the primary concern but is subjugated to the context (context of application, of the learner, of the teacher, of the time).

There is not a clearly defined linear progression of what mathematics should be taught and in what order. Achieving a coherent mathematical education for each child is important, but this is not the same thing.

2. Ways mathematics can be taught and learned.

It follows that you cannot simply hand over your mathematics (or anyone else's) to children.

The teacher is there to promote and facilitate learning, to provide starting points for an experience, to guide and respond.

I first appreciated the futility and irrelevance of much of our traditional classroom teaching when I read Caleb Gattegno's hilarious parody of the passing on of knowledge to children, via lessons, tests, homework, examinations, etc., in his book "What we owe children". (3)

(4) A. N. Whitehead also had similar things to say about this, particularly about ´inert knowledge´. (I´m not sure whether to feel encouraged or worried to discover that President Carter reads the same books as me!)

Denis Kennedy has already emphasised the need for a variety of modes of learning and teaching. I support his view so stronly that I would like to repeat what he said:

"The teaching methods should change; one day a student might be working alone, later he is paired off with another, a week later he might be grouped with 5 other students and at some time he might find himself in a class lesson."

(I think that I would have said that he should find himself in a class lesson.)

All my experience tells me how important this statement is, and it is a view strongly supported by the Schools Council working party.

How have we got away with the monotony of class lessons for so long?

In particular I feel that I must oppose fiercely the use of individualised learning programmes where they are used to the exclusion of all else - as in England they so often seem to be - and where students are left to plough their own lonely furrow for lesson upon lesson, working at ´their own pace´ - accurately observed by some to mean ´snail´s pace´ all too often.

3. Respect for children and their work.

There has to be respect for children as doers and creators of their own mathematics. Their feelings have to be respected and their point of view listened to, developed and encouraged.

Discussion of their mathematics, writing about their mathematics are crucial and essential steps in their mathematical development. Teachers of mixed ability classes have been quick to recognise this.

There is little new here. A number of teachers have accepted all that I have said. English primary schools contain many such teachers. At secondary level however, this has rarely been the case, and still is not.

So far I have talked in rather general terms and may not have been as specific as some of you would have liked. I will try to remedy this.

Successful teachers of mixed ability groups have forced to use not only a variety of styles and modes of teaching but also a variety of materials and texts. They have been eclectic in their choice of text-books or work cards. No one text-book or scheme is good enough for a single child. How foolish that we ever believed it to be so!

In the early 1960's many felt that the introduction of the 'new math' would solve some of our problems and enable us to produce a numerate population. I remember writing in 1970 that my fear was that when the dust settled after this 'revolution', little would have changed and we should be no further forward along the difficult path of maths education.

Ten years later I think that current practice, at least in the U. K., supports my view. The issue is not about content and teachers of mixed ability groups are aware of this.

Peter Coaker, who is at Berkeley, a member of British Petroleum and an enthusiastic and noted supporter and worker for maths education in England, recently suggested at a meeting of the Schools Council Mathematics Committee that it would be a good idea if, when the time came to finally assess pupils′ competence at mathematics before they left school, we sat four children around a table, presented them with a problem and then asked them to talk about it. He went on to suggest that such an assessment might constitute half of their final assessment.

Teachers of mixed ability groups would leap at this splendid proposal! My guess is that many others would be terrified by the prospect.

I have already mentioned the need to focus on individuals. One particular development has been the attention paid by teachers to the mistakes made by children and the analysis of these mistakes.

Examples of this from my own classroom and others are well illustrated in two articles published recently by David Kent, a former colleague and a friend of mine, published through the National Foundation for Educational Research, entitled "Some Ways In Which Mathematics Is Lost". This research was undertaken by David as just a part of his normal classroom activity as a teacher in our mixed ability classrooms at Belper and elsewhere.

I was, for example, able to appreciate why Susan thought that $2x - 5 = 39$ was a stupid statement, because the classroom situation allowed us to sit and talk about it. (It wasn′t because Susan couldn′t accept x as a number. It wasn′t because she didn′t like equations. It was in fact because she couldn′t see how you could take 5 away from 20 something and be left with thirty-nine.)

Teachers teaching mixed ability classes have again been forced to work together more closely (as Denis Kennedy has illustrated), enabling strengths to be utilised, weaknesses supported, interest developed. Chuck Allen in his talk has indicated just how wide and diverse this spectrum of interests, talents and experience is.

This has led to a much needed greater degree of professional honesty between teachers. Many of the mathematics department at my own school seem to find it difficult to cope with my regular discussions about the problems that I am having in teaching mathematics (they have not been used to teaching mixed ability groups and working together in this way). He is the Head, I can see them thinking, and he has all these problems and he talks about them!

But in addition to co-operation there has to be autonomy for the teacher. Individualised learning programmes threaten and sometimes remove this all together.

Autonomy of the teacher in one sense has been a noted feature of the English educational system, although at present it is seriously threatened by frightened politicians and powerful employers and others who do not understand the complexity of the problems faced by teachers.

Autonomy in another sense will always be there. As I indicated earlier, the teachers' attitude, relationship with children, view of mathematics, emphasis of particular topics etc. are all of paramount importance and no prescription or statute from above will ever change this fact.

There must also be student autonomy. What work to do, when to do it, how long to spend on it, who to consult with, what books to refer to, how to record the work . . ., these are all legitimate claims for students to make and teachers to accept.

Mixed ability classes have frequently accepted this need and faced the consequent organizational re-adjustment. But the re-adjustment is not the problem. The problem was accepting the need for it.

I think many of us have been (and still are) constanly amazed by the ability, persistence, resilience of children to accept responsibility for their own learning, to work on their own for periods of time, to sustain a piece of work for weeks, to accept the responsibility that goes with the freedoms offered.

Teachers of mixed ability groups have regularly reaped this reward.

The need for variety also applies to assessment. The foolishness of trying to assess mathematical competence by a single means of examination now seems transparently obvious.

In mixed ability teaching it just isn´t possible to get away with this. It isn´t desirable in any sort of teaching.

Finally, one hobby horse.

During the last ten years I have found one vehicle to help meet the challenge posed by some of the problems mentioned. I am speaking of the use of mathematical investigations in the teaching of mathematics.(6)

I have had children of all ages spending as much as seventy per cent of their time on investigative work. The advantages have been considerable:

1. they have encouraged children to spend more time on the

processes and strategies in mathematics.

2. they have given the children an apportunity to create and develop their own mathematics.

3. they have enabled children (including the least able) to get a feel for pure mathematics, and to know what it is to work as mathematicians.

4. they have encouraged children to discuss their mathematics and to write about it.

Ten years ago there seemed to be only a handful of teachers working in this way with children. The growth of mixed ability teaching has helped to promote more use of investigative work and I was delighted that this Congress was able to make space for a panel on this topic.

The conference programme refers to ′disadvantages′. What can I say? It is very hard work but you seem to learn a lot. I feel certain that the development of mathematical education has been enhanced by the contribution made by mixed ability teaching.

KEEP MOVING

Drivers of cars are always being urged to keep a ′safe distance behind the car in front.′ But what is safe?

Drivers in Holland are advised, by the Dutch Highway Code to ′....keep at a distance in metres which is half the speed (in km/hour) at which you are driving.′

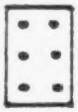
So a Dutch driver driving at 60 km/hour, should keep 30 m behind the car in front of him.

Suppose that, on a new busy city ring road in Holland, the intention is that as many cars as possible should be able to use the road simultaneously. That is, that each minute as many cars as possible should be able to pass any particular point. Taking account of the Dutch Highway Code advice and assuming the average length of a car is 4 m, how fast should cars travel?

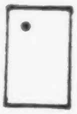
BRAILLE

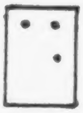
Louis Braille, a Frenchman living in the 19th Century, invented an alphabet for use by blind people.

The alphabet consisted of raised dots in rectangular patterns.

Each pattern of dots was based upon a 2 by 3 rectangle: 

Some patterns used are given below:


A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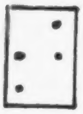
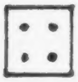

T

How many different patterns can be made using this system?

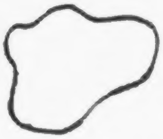
Suppose Braille had used this  as his basic pattern. How many possible patterns now?

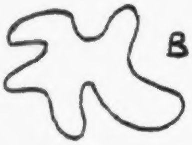
What about a 2 x 4 rectangle? Any rules?

COMPACTNESS

What does this mean? Can you explain what we mean by compactness without drawing a diagram to help you?

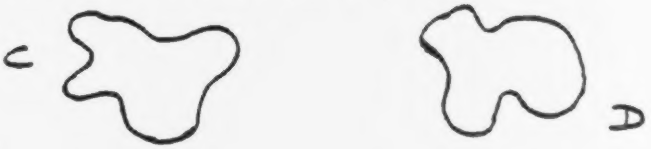
Which is more compact, A or B:


A


B

Most people would agree that A is more compact than B.

But what about these two shapes:



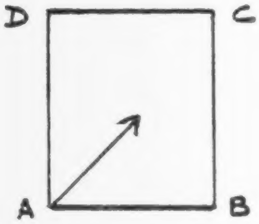
Not so easy!

How can you measure compactness?

Invent some ways of measuring it, and then test them out.

BILLIARDS

I have a rectangular billiard table with pockets at the four corners A, B, C and D. I start with a ball at A, and hit it along a path at 45 degrees to the cushion, thus:



Assuming that

1. the ball rebounds from the cushions at 45 degrees
2. it keeps rolling until it drops into one of the pockets
3. the length and width of the table are both integral and known,

is it possible to predict:

a. which pocket the ball will end up in, and

b. how many times the ball will have hit a cushion?

Investigate the situation if the ball is initially hit from E (still at 45 degrees to the cushion), where AE = 1 unit and E lies on the cushion.

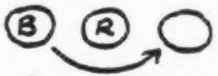
FROGS

Place two red pegs and two blue pegs in a line on a pegboard with a hole in between them: Ⓑ Ⓑ ○ Ⓡ Ⓡ

Try and interchange the blue and red pegs but moving them only according to these rules:

1. Blue pegs move only to the right, red pegs only to the left.
2. A peg may move either a) into an adjacent hole, or b) by jumping over a single adjacent peg of the opposite colour into a hole.

Can you interchange the pegs using these rules? If so, how many moves does it take? eg.



Try the problem again with 3 pegs of each colour.

How many moves are needed for n pegs of each colour? Can you prove your results?

Suppose there are m red pegs and n blue pegs.

CHAINS

17 → 52 → 26 → 13 → 40 → ?

What is the next number in the chain? What are the rules?

Continue this chain, and then, make some more of your own, starting with different numbers.

What happens? Does every chain end the same way? What is the longest chain you have got?

Invent some new rules and investigate your new chains.

The children's work in this pamphlet was produced by students at Belper High School, Derbyshire and Northcliffe Comprehensive School, Conisbrough, England.

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ISBN 0 900095 35 0

THE GAME OF GRAB WITH VARIATIONS

Bob Jeffrey and variations by Helen L. Miller

Several summers ago Bob Jeffery, Principal Lecturer in Education and Mathematics, West London Institute of Higher Education, England, introduced an activity called "Grab" at a Teachers' Center Summer Workshop.

Bob Jeffery described "Grab" as a game played by 7 year olds to give them a feeling for factoring and for prime numbers. He invited teachers to use this game in a way that is commensurate with the needs of their students.

The activities in this Seedling have been bent, stretched, and adapted for children from 5 to 7 years of age. These variations of "Grab" have helped the children relate to the following skills and concepts:

1. prime numbers
2. meaning of "greater than" and "less than"
3. sets of 2, 3, 4, 5
4. estimating
5. counting

Try these activities and then bend and stretch them in order to facilitate learning for the children in your class. There is one very important rule. You must share what you have learned with at least one other teacher.

The materials needed to play this game are very simple. For the following variations it is best to have items in two colors - blue and white buttons, or red and white poker chips, or cereal that comes in two colors. The cereal is advantageous because the winners can eat the cereal when they're finished.

This game may be played by a large group of children, by one child (use cards for each direction), by a small group of children when time permits. After the children have played "Grab" several times, ask them to think about some rules they have used to play the game. The children may suggest new ways that the game can be played.

Grab 1

Each child is given 5 white chips and 5 blue chips. (For younger children it is best to begin by giving each child his own supply of chips.) Each child puts his chips in a pile in front of him. Remind the children that they are to take "some". They must not count them before they grab.

Directions: Grab some chips. If you have more blue chips than white chips, you win. Return the chips to the pile. Grab again. If you have more white chips than blue, you win. Return the chips to the pile. Grab again. If you have less blue chips than white, you win. Return the chips. Grab again. If you have less white chips than blue, you win. Return the chips. Grab again. If you have the same number of white chips as blue, you win. Return the chips.

This game may be repeated several times. The terms "greater than" and "fewer than" should be substituted for "more than" and "less than". If a child is having difficulty with these terms, begin by using the term "different from". (That is, "If the number of white chips is different from the number of blue chips, you win.")

Grab 2

Each child needs 10 chips, all the same color.

Directions: Grab some chips. If you can put them in sets of 2 without any left over, you win. (Repeat this game several times.) How many sets of 2 do you have? How many chips do you have? What is the least amount you have to have to win? Now put all 10 chips in sets of 2. How many sets of 2 do you have? How many chips do you have? Return the chips to the pile. Grab some chips. If you can pu the chips in sets of 2 without any left over, you win. What is a goo number of chips to take? What other amounts of chips can you put int sets of 2 without any left over? Now use the chips to see if your number was a good one.

Grab 3

Use the same directions as those for Grab 2. This time change the set needed to win to a set of 3. Then do the same steps using a set of 4 and then a set of 5.

As the children become more proficient at the game, increase the number of chips each child has to 15. Finally, give each child a random number of chips, or ask two children to share their chips.

Grab 4 (The original game from Bob Jeffrey)

Four children play this game using a pile of cubes or pebbles. Each player grabs a handful of cubes. The scoring system is as follows:

2 points if you can make sets of 2 with no remainder

3 points if you can make sets of 3 with no remainder

4 points if you can make sets of 4 with no remainder

5 points if you can make sets of 5 with no remainder

That is the end of the game - each player totals his points.

Grab 5

Each player has 10 chips in front of him. Grab some chips. Count the chips which you have grabbed. How many are left in the pile? Are there more or less chips left in the pile than you grabbed? Return the chips to the pile. Grab some chips. Count the chips in the pile. How many chips did you grab? Don´t count them. Return the chips to the pile. Grab some chips. If you can put the chips in sets of 2 without any left over, you win. How many chip are left in the pile? Can you put the chips in the pile in sets of 2? Return the chips. Grab some chips. If you can put the chips in sets of 3 without any left over, you win. Can you put the chips in the pile in sets of 3 also?

If young children are playing the original game, the beadstring will help them keep track of their points. The beadstring, which uses 10 beads of one color, then 10 of another color, is a handy tool for computing one´s score when any game is played.

Each child should have his own beadstring. Each time a player has a new score to add to previous points, he counts the correct number of beads from the last total. A clip clothespin will hold his place until he is ready to add another score.

COMPENSATION TASK

Gail Ahrens

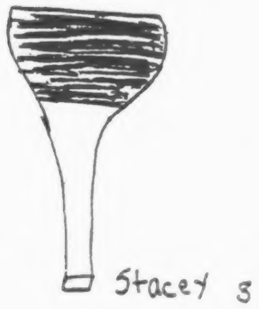
The purpose of this task was to observe children's ability to compensate for a change in the water level in a glass bottle with a long narrow top and a wide base. The bottle I used holds 750 ml of water when full. I filled the bottle half full (375 ml) and colored the water with blue food coloring so it would be easier for the children to see the water level. In the first group, I showed them the water level in the bottle right-side-up, asked them to imagine it up-side-down, and draw a picture of the bottle up-side-down showing the water level. In the second group, I showed them the water level in the bottle right-side-up and then up-side-down and asked them to draw a picture of the bottle up-side-down showing the water level.

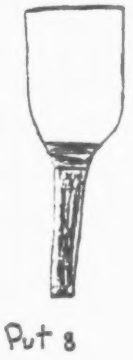
In the first group, which did not see the bottle up-side-down, out of a group of 21 students, nine children (6 age 8 and 3 age 9) showed the water still in the bottom of the bottle, which is impossible. Five other children, all age 8, showed the water all in the narrow neck of the bottle and six children (4 age 8, 1 age 9, and 1 age 10) showed the water level above the neck of the bottle turned up-side-down, but still lower than it really was. One child, age 8, drew the bottle right-side-up and drew the water at the top of the bottle in the long neck.

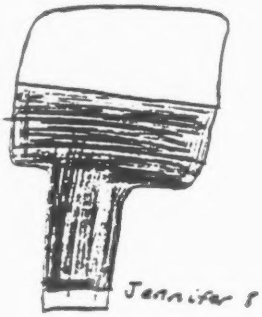
The children in the first group, who only saw the bottle right-side-up, could not visualize the level of the water with the bottle up-side-down and draw a picture of it correctly. They could not compensate for the long narrow neck of the bottle. Almost half o the children (9) in this group could not visualize the water being in the top of the bottle when it is turned up-side-down.

The second group, which saw the water level with the bottle up-side-down, produced drawings close to the correct level of water except one child (age 8) whose drawing of the bottle was rather strange and the water level too high. The rest of this group (18 age 8 and 1 age 9) came very close to showing the correct level of the water in the up-side-down bottle.

The results of this task show that when the children I tested (third grade-age 8 or 9) could actually see the level of the water in the up-side-down bottle, they could come closer to drawing it correctly than most of the children who were asked to visualize the water level in the up-side-down bottle and draw it. Most of them are not able yet to compensate for the long narrow top of the bottle and believe the water level is lower than it really is. Only six children out of the group that had to visualize the level of the water in the bottle when it is turned up-side-down came close to drawing the correct water level. These children are better able to compensate for the long narrow top of the bottle than the rest of their classmates.







PIGPEN

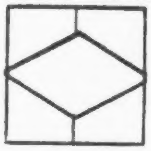
Barb Leardi

Knowledge is internalized action. To me this means we have experienced our growth--not merely experienced the acquisition of facts. Many times we have heard kids say, "I don't get why, but it works this way!" There are many ways to use short cuts to free up ou time, but not to short cut kids. We can use all the quickies to save us steps, words, time, but not to cut experience from kids.

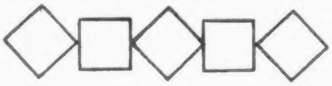
Sometimes we teachers complain about noise--quiet days are found naturally when kids are using their time as an "Age of Discovery" rather than a have to do repetitious lesson.

Recently we tried a new game--PIGPEN.

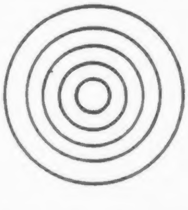
When we have 5 pigs and wish to make 4 sided pens for each pig, what is the smallest number of fences (lines) needed?



What is the largest number of lines (fences) needed to fence in 5 pigs (each in its own four-sided pen.)?



The students tried many different arrangements and easily settled on 20 as the most number of 4-sided fences needed for 5 pigs. Then we removed the restriction of 4-sided and the pigpens were "rounded down" to 5 lines.

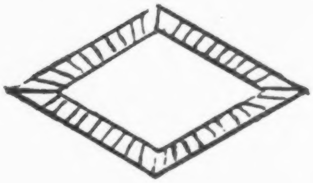


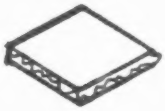
The point here seems to be that thinking kids can discover many right answers and feel good about their accomplishments. This exploration in learning also produces a sharing of discoveries and a cooperative effort in approaching problem solving.

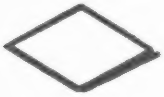
A SQUARE MEAL

Judy Stepp

Concept: Recognition of shapes as a way of classifying and as a way of ordering the physical world is basic to early experiences in understanding mathematics. Every aspect of the school day schedule can repeat for the child the concepts you are helping him to learn. You can help him notice many things about form he has never really understood if you relate these things, for instance, to the food he eats. He will notice his cracker is a circle and his celery a straight line or perhaps a stick. His uncut sandwich is a square and he can change the shape of his food with his teeth.







Activity: At snack time we sat down on our straight chairs at our rectangular tables, pulled out our square napkins, and began to eat our square cheese sandwiches from our square paper plates.

Other foods to emphasize squareness and straightness: square luncheon meats; square cookies and crackers; celery sticks; cubes of ice cream in little boxes; fruit juice ice cubes with small sticks frozen into them.

The same ideas can be carried out using round foods such as pineapple slices, sliced oranges, scoop of cottage cheese with a maraschino cherry on top, and round crackers. At a later time, more than one shape could be used at the same time.

Adapted from The Amazing Life Games Theater . Houghton Mifflin Company, 1971.

Understanding Shapes by Cutting Shapes

David L. Stepp

What better way to study shapes than to cut shapes? The materials are basic - paper and scissors. Asking directive questions is the key to promoting thinking and eventual understanding.

> "How can I make this rectangle into a square?"
> "What do I have left?"
> "If I cut from one corner of this square to the opposite corner, what will I get?"
> "What is another way of cutting a triangle?"
> "Will I need the corners of the paper to cut a circle?"

Children should be taught to cut correctly. Provide verbal information while demonstrating the process.

> "Open the scissors wide instead of taking short, choppy strokes."
> "Turn the paper (not the scissors) so the scissors are pointing in the direction you want to cut."
> "Turn the paper while cutting a curved edge."
> "Hold the paper still in order to cut a straight edge."
> "To cut a circle, turn the paper continually and evenly."
> "How slow or how fast the paper is turned will determine the size of the circle."
> "If you turn the paper fast, you will get a small circle."

Taken from: Arts and Activities , November, 1982. "The Shape of Things To Cut", Lila Borgman Lothson.

SIZE RELATIONSHIPS USING FRACTIONS

Mary Steffen

Preparation:

1. Make this set of cards.

$$\boxed{1}\ \boxed{\frac{1}{8}}\ \boxed{\frac{2}{8}}\ \boxed{\frac{3}{8}}\ \boxed{\frac{4}{8}}\ \boxed{\frac{5}{8}}\ \boxed{\frac{6}{8}}\ \boxed{\frac{7}{8}}\ \boxed{\frac{8}{8}}\ \boxed{2}\ \boxed{\frac{1}{16}}\ \boxed{\frac{2}{16}}\ \boxed{\frac{3}{16}}\ \boxed{\frac{4}{16}}\ \boxed{\frac{5}{16}}$$

$$\boxed{\frac{6}{16}}\ \boxed{\frac{7}{16}}\ \boxed{\frac{8}{16}}\ \boxed{\frac{9}{16}}\ \boxed{\frac{10}{16}}\ \boxed{\frac{11}{16}}\ \boxed{\frac{12}{16}}\ \boxed{\frac{13}{16}}\ \boxed{\frac{14}{16}}\ \boxed{\frac{15}{16}}\ \boxed{\frac{16}{16}}\ \boxed{1}\ \boxed{0}$$

2. Have on hand grid paper, crayons and perhaps geoboards with several colors of rubberbands.

Rules:

Arrange these cards in smallest to largest order. All cards need not be used in each solution. Multiple solutions are possible. Use grid paper and crayon to work out sizes.

Hints:

Some solutions may be offered with different spaces between each number. More thinking takes place if equal distances are maintained between each number.

Possible Easy Solutions:

$$\boxed{0}\ \boxed{\frac{1}{8}}\ \boxed{\frac{2}{8}}\ \boxed{\frac{3}{8}}\ \boxed{\frac{4}{8}}\ \boxed{\frac{5}{8}}\ \boxed{\frac{6}{8}}\ \boxed{\frac{7}{8}}\ \boxed{\frac{8}{8}}$$

$$\boxed{0}\ \boxed{\frac{1}{8}}\ \boxed{\frac{2}{8}}\ \boxed{\frac{3}{8}}\ \boxed{\frac{4}{8}}\ \boxed{\frac{5}{8}}\ \boxed{\frac{6}{8}}\ \boxed{\frac{7}{8}}\ \boxed{1}$$

$$\boxed{0}\ \boxed{\frac{1}{16}}\ \boxed{\frac{2}{16}}\ \boxed{\frac{3}{16}}\ \boxed{\frac{4}{16}}\ \boxed{\frac{5}{16}}\ \boxed{\frac{6}{16}}\ \boxed{\frac{7}{16}}\ \boxed{\frac{8}{16}}\ \boxed{\frac{9}{16}}\ \boxed{\frac{10}{16}}\ \boxed{\frac{11}{16}}\ \boxed{\frac{12}{16}}\ \boxed{\frac{13}{16}}\ \boxed{\frac{14}{16}}\ \boxed{\frac{15}{16}}\ \boxed{\frac{16}{16}}$$

$$\boxed{0}\ \boxed{\frac{1}{16}}\ \boxed{\frac{2}{16}}\ \boxed{\frac{3}{16}}\ \boxed{\frac{4}{16}}\ \boxed{\frac{5}{16}}\ \boxed{\frac{6}{16}}\ \boxed{\frac{7}{16}}\ \boxed{\frac{8}{16}}\ \boxed{\frac{9}{16}}\ \boxed{\frac{10}{16}}\ \boxed{\frac{11}{16}}\ \boxed{\frac{12}{16}}\ \boxed{\frac{13}{16}}\ \boxed{\frac{14}{16}}\ \boxed{\frac{15}{16}}\ \boxed{1}$$

Alter The Rules:

Each solution must have some eighths and some sixteenths.

Possible Solutions Involving Thinking:

0	1/16	1/8	3/16	2/8	5/16	3/8	7/16	4/8	9/16	5/8	11/16	6/8	13/16	7/8	15/16	1/1
0	1/16	1/8	3/16	2/8	5/16	3/8	7/16	4/8	9/16	5/8	11/16	6/8	13/16	7/8	15/16	8/8
0	1/16	1/8	3/16	2/8	5/16	3/8	7/16	4/8	9/16	5/8	11/16	6/8	13/16	7/8	15/16	1

Focusing Questions:

Which solution leaves out the fewest fractions? Why? What patterns can be found in the solutions? Can the leftovers from one evenly spaced solution be used to make another list with equal space between each number? What patterns can be found looking at 2 solutions at once? Are some cards never used? Why?

Note:

A good way to bring fraction size relationships into a real lif context is to bring a set of socket, or open ended wrenches labeled eighths and sixteenths.

Bends:

Other sets of fraction cards could be made using halves and fourths, fourths and eighths, fourths and sixths, etc. Eventually sets could be mixed and students could work out a personal number lin of fractions.

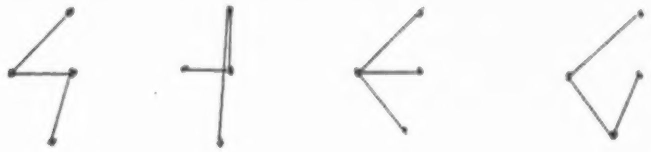
Same thing can be done with decimals or a combination of common fractions and decimal fractions. Play "I'm thinking of a number between zero and one."

CONNECTING POINTS

Gay Rasler

Make two points on a paper. Have the students connect the points with a straight line segment. Then ask, "Can you do it any other way?" After discussing it add another point. How many line segments can be drawn to connect the three points? What figures have been drawn? Then investigate four points. What are some ways you can connect the four points using just three lines?

Example:

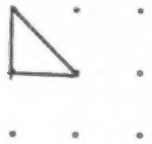


The project can be extended by having the children connect the four points with four lines or an unlimited number of lines.

SOME GEOBOARD ACTIVITIES

Linda Van Valen

Can you make



Can you make your rubberband touch only 2 points? 5 points? 6, 7, 8?

Can you make your rubberband touch 2 points with 4 points in the middle?; touch 3 points with 3 points in the middle?; touch 5 points with 2 points in the middle?; touch 8 points with 1 point in the middle?

DIVIDING

Carla Kim Wedekind

This Seedbed article grew from what was shared by Virginia Sma at the Winter '83 Teachers' Center session. I used her idea and ad a few of my own adaptations. She proposed the idea of giving child one hundred bottle caps (checkers, bingo chips, plastic lids, etc.) and asking them to divide them up equally between themselves. I thought that sounded extremely rich, so I tried it too. It is so interesting to see how different aged children accomplish the task many different ways. Younger children will deal them out one at a time - often losing his/her place, thereby giving some people more than others. Others will dump them in a pile, with each person tak one at a time simultaneously. Some deal out two at a time while others stack them in piles of five, then pass out the piles.

There were so many different solutions to the problem that I can't begin to write about them all. You would find even more solutions with a different group of kids.

It would be interesting to add another person to the group just when they have the objects equally divided.

You can also change the format of the game if you used an assortment of different types of bottle caps for the pile of one hundred. You can make it into a game of classification. The student are asked to group the caps into piles that are similar.

You may also take out a handful of caps and ask the student to use their inference skills to estimate how many caps are left.

One hundred bottle caps can pose even more problems than the one that are listed above. Maybe you could think of more!

COMMENTS FROM THE PIAGET PRIMER BY ED LABINOWICZ

Virginia Small

If you haven't had a chance to read The Piaget Primer by Ed Labinowicz take time to do so. It should be considered a must for al teachers. Reading this book has caused some "soul searching" about our paper and pencil classrooms. Dr. Labinowicz states, "The more meaningful and varied the child's encounters with the real world are in these early years, the stronger his foundation for logical thinkin and his receptivity to mathematics instruction will be."

"Although Piaget calls for a gradual and systematic development of ordering, classifying activities, etcetera, he also supports spontaneous play. Spontaneous play not only develops the child's capacities for representation, but also provides him with opportunities for development of physical and logical knowledge and perceptual abilities."

"Block-playing allows children to develop physical knowledge about properties of the blocks. Furthermore, opportunities to classify arise spontaneously during building and children may discover that the large blocks don't fall down as easily when at the bottom. Subsequently, they might begin by grouping blocks according to size prior to construction."

"Throughout the block-building, the alert teacher will recognize opportunitees for entering the activity to extend the child's thinking."

Labinowicz referred to George Hein who said that before entering school children interact with the world. By the time they enter school a distinction is made between work and play. You can learn from work and you don't learn from play. "This discussion (about work and play) becomes particularly significant when we remember that we are talking not just about learning particular things but about learning how to learn, developing intelligence. The adverse consequences of insisting on "work" in school is that we are depriving the children of the opportunity to develop intelligence."

"Anyone who makes the attempt to expose children (or adults) to the kinds of situations where alternative modes of learning are legitimate, will soon see that different individuals learn in a surprising number of ways and that the distinctions between work and play will simply vanish in a wealth of activity."

Piaget says, "The goal of intellectual education is not to know how to repeat or retain ready-made truths. (A truth that is parroted is only a half truth.) It is learning to master the truth by oneself at a risk of losing a lot of time and going through all the roundabout ways that are inherent in real activity."

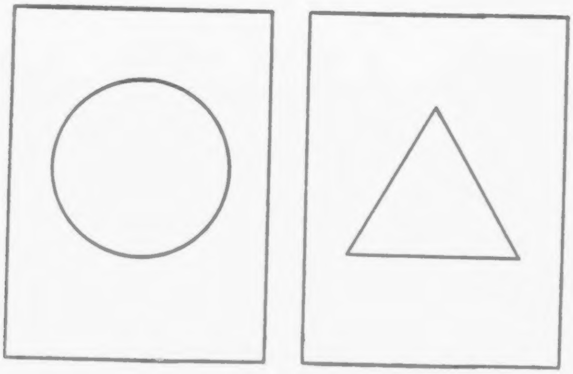
"At all levels, including adolescence and in a systematic manner at the more elementary levels, the pupil will be far more capable of "doing" and "understanding in actions" than of expressing himself verbally --"awareness" occurs long after the action.

Perhaps by now you are asking when or where these activities could be worked into an already crowded day. I had the same thoughts at first. I do know that if we as teachers feel something is important we will find the time. The first grades at our school set aside thirty minutes a day for center time. During this time the children work with creative materials we have slowly collected, had donated, or have purchased. If you talk to the children and listen to their reactions this is the special time of day for them. This is a time to work in small groups freeing the teacher to circulate, observe, listen, and perhaps suggest a question to ponder. Join us and give this creative time a try.

SHAPING UP THE CLASSROOM

Judy Stepp

Windows are rectangles, and we look through them without always realizing how their straight edges and right angles organize the view for us. Try changing the shape of a few windows by taping large pieces of cardboard with triangular or circular openings over the regular frame. Looking through these shape windows is a new experience which you can talk about to draw attention to all the round things outside.



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*The Amazing Life Games Theater. Houghton Mifflin Co. 1971.

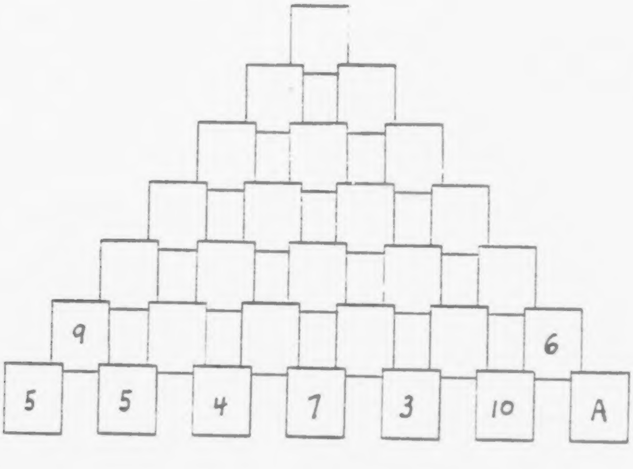
MATH SOLITAIRE PYRAMID

Mary Louise Kane

The object of this game is to review or learn math fact families. Use a set of playing cards or make your own cards. Face cards would be as follows:

Ace = 1
Jack = 11
Queen = 12
King = 13

For reviewing the number facts of 10, use all cards Ace to 10. Leave out the jacks, queens, kings, and jokers. Make a pyramid with one card at the top and build so that the bottom row has 7 cards all face up.



The object is to remove cards that have a sum of 10. The number 10 is wild when matching cards with sums of 10. To remove a card, it must not be covered by another card. In the example above, the 9 cannot be removed until the two 5's are removed. The remaining cards are turned over one at a time to match those that are in the pyramid. Repeat the process until no more matches can be made or until the game is over. When the top card is removed, the game is over.

Variations: Use all cards to work sums of 13 or use fewer cards to do sums of any number. When doing other number facts, the number of cards in the bottom row needs to be altered so that there will be enough extra cards to use to make matches.

Sums of 8 and above - 7 cards in the bottom row
Sums of 7 - 6 cards in the bottom row
Sums of 5 and 6 - 5 cards in the bottom row

SEQUENCING NUMBERS

Ann Turvey

You will need a game board with 100 squares arranged in a 10 x 10 array. (I have some of these in a size that will fit on a child's desk and some that are larger for several children to use together on a table or on the floor). You'll also need a large number of disks that have numbers written on them. (I use the plastic caps from milk jugs.) Most of the sets of disks have the numbers 1 - 100 on them, but some can have 200 - 300 or 800 - 900 etc.

The childs a set of 100 disks in a container and the gameboard and it is his/her task to put them on the game board in order.

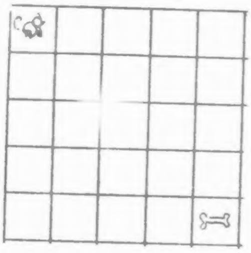
This is an excellent way for children to practice sequencing, but perhaps even more important is the fact that you, the teacher, have an excellent arena for child-watching. A few minutes of observation can tell you a great deal about what the child understands about numbers. Watch and see.

NUMBER SEQUENCING

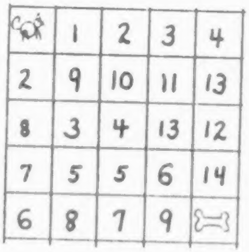
Mary Ann Sommers

Tracing a number sequence through a grid maze is fun for young children. In addition to providing practice for number sequences it also provides alternative searching experience. An even richer activity is for the children to make the grid mazes that contain number sequences.

Give each child some grid paper. (S)he decides on a starting point and a finishing point. They enjoy using drawings to mark these (i.e. a dog that reaches a bone, etc.)



(S)he then writes in the number sequence (starting with the dog and ending with the bone).



	1	2	3	4
2	9	10	11	13
8	3	4	13	12
7	5	5	6	14
6	8	7	9	

Then other numbers are added to provide alternatives that end up in blind alleys.

These can be laminated (with or without an answer key on the back) and then shared with other children.

These puzzles were made by second graders at Albers Elementary School in Albers, IL.

	1	3	4	4	6	10	3	10
5	4	2	3	5	5	4	9	11
3	5	3	4	8	7	6	8	7
8	7	2	3	9	8	7	10	9
4	4	3	4	10	9	8	7	8
9	8	4	9	11	9	3	10	11
10	9	3	10	10	9	8	9	4
8	7	6	3	11	12	8	7	9
9	7	10	9		12	13	6	8

1		1	3	4	5	6
2	2	2	4	5	7	10
3	3	4	5	6	8	9
4	5	6	6	7	8	9
5	7	8	7	13	10	10
8	6	9	8	12	11	11
10	9	10	14	13	12	16
11	10	11	11	15	14	15
12	11	11	12	13	15	16
13	14		20	19	18	17

2		1	13	14	15	16
1	2	1	12	11	18	17
3	2	3	10	19	12	14
4	4	7	9	20	13	15
5	6	5	8	21	22	23
6	6	7	9		25	24

10	9	8	7	6	30	29	28
	2	3	4	5	31	♡	27
1	20	21	22	23	24	25	26
2	2	20	19	15	14	13	14
5	4	3	12	18	17	12	15
6	5	11	4	13	16	11	16
7	9	10	5	14	15	10	17
9	8	7	6	7	8	9	18

This activity was adapted from an idea in Enrich " the good idea people ", a division of Ohaus, 1980.

COMPUTERS

Barb Leardi

Computers are everywhere! People are talking about them, mystified by them and drawn to them. Eight-year old children are learning to program computers and to compare programs with remarkable efficiency. Software is available to help people do almost anything they choose to do - play chess, design a bridge, or calculate income tax.

In the midst of all this, let us not forget that our mind is the original computer. The human mind not only planned all the computers around today, but also programs them, improves then and repairs them.

The human mind is a fascinating computer on its own. It programs -- even at the early age of a few weeks, our human computer begins to sort out information and categorize faces and voices. Shortly after birth our computer learns that help is coming when a certain voice is heard. Throughout every stimulating day of its life our computer brain programs our next move whether it be in soccer, swimming or scheduling a course or a date with a friend.

Our computer stores and recalls -- this is where real experience benefits our computer brain. Knowledge acquired through experience can be stored much more efficiently and recalled with so much ease than facts we hear about. When one of our senses experiences a new event, our computer brain compares it to other events stored in our memory banks. So we are reminded of a whole chain of experiences.

Perhaps best of all our computer brain can compute and here, too experience is the best teacher. Instead of becoming overused or worn out our computer brain gets better and better as we try more and more calculations and computations. It seems to thrive on training and different working conditions.

And, fourthly, our computer can entertain and amuse. It can constantly think up new ways to help you enjoy all of its assets. The far reaching imagination allows us new horizons in music, art, and other creative endeavors. It is fun to use. It is effortless to turn on. It is effective whether alone or with others.

As we use our computers more and more we are able to interact with other humans and their computers. Best of all when given the opportunity to use an electronic computer we can enjoy all the programs, while adding even more strength to and from our own computer brain.

NUMBER RELAY

Melba Rendleman

I divide the class into two teams. I call out a number. Each team sends its first person up to write another name for that number. The player then goes to the back of the line.

After each child has had a turn, I tally the points. The team with the high score wins. I sometimes use the same number for the entire game, or I may change the number for each turn.

Example:

⑦

Team 1		Team 2
4+3	8-1	5+2
6+1	17-10	9-2
2+2+3		14-7

Team 1	Team 2
𝍸	|||

The idea was taken from Happy Math .

HOW BIG A SQUARE IS YOUR FRIEND?

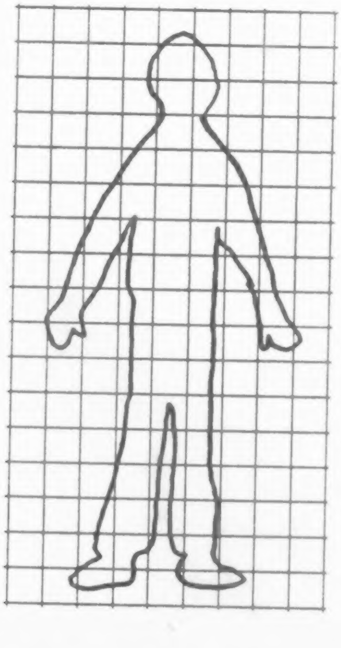
Bonnie Wagahoff

This activity provides the child with an early experience in counting and recording large numbers. His concept of square measure is reinforced and extended. He gains a greater understanding of his physical size and shape and how he compares in size and shape with others.

Materials:
graph paper (1" square), crayons, markers, scissors, masking tape

Directions:
1. Working with a friend, tape sheets of paper together to make two sheets large enough to lie down on.
2. Have your friend lie down on one sheet of graph paper.
3. Draw his outline with a crayon.
4. Have your friend count the number of squares within his outline.
5. Have him cut out his shape, write his number of squares and name on it.
6. Have him draw his face, clothing, all details, color it in, and pin it up. (It could be colored one square at a time.)
7. Have your friend make your outline on the other sheet of graph paper.

Example:



Helpful questions to ask:
1. How many squares did you count inside your outline?
2. Which part of your body covers the most or least squares?
3. If your outline had been drawn with your arms outstretched, would you have a different answer?
4. How can you arrange your body to achieve the largest possible shape? The smallest possible shape?

Extra Activities:
1. Make a number line, marking appropriate units, to record the number of squares your outline enclosed.
2. Add your number of squares to the number of your friends.
3. How could you use your outline to measure your height?
4. Count the number of squares covered by your foot, your hand, and so on.
5. Can you make a graph of the number of squares covered by your outline?
6. Collect ten leaves. Outline them on graph paper and count the squares enclosed by each leaf and color then in.

Editor's Note - Can you make an average boy/girl of your grade?

SHOW YOUR INVENTIVENESS

Maggie Burhite

Make a collection of things like cotton balls, straws, paper clips, rubber bands, tongue depressors, spools, strings, wire, pieces of aluminum foil, styrofoam, etc., etc., etc.

Divide the children into small groups - give each group a bag with an assortment of the items you gathered in it. Give each group a half an hour or more to come up with an invention.

At the end of the alloted time, ask each group to tell what their invention is called, what it does, and show how it works.

ONE SOLUTION TO THE PROBLEM OF CONSECUTIVE SUMS

R. Lynn Bradley

$$15 = 7 + 8$$

$$9 = 2 + 3 + 4 \quad \text{or} \quad 4 + 5$$

$$10 = 1 + 2 + 3 + 4$$

These three numbers can be written as the sum of two or more consecutive integers.

Starting with any number, say 42, can it be written in consecutive integers? If so, how can it be done? One possible solution is the following:

1. Take one-half of the number, e.g., in the example above 42 - 2 = 21;
2. 21 can be written in the consecutive integer manner as 10 + 11 (of course all odd numbers can be written in that way.)
3. Then add to 10 + 11 the numbers just below and just above those two, i.e., 9 + 10 + 11 + 12 = 42.
4. For instance, 26 = 5 + (6 + 7) + 8. (6 + 7 = one half of 26 as shown in steps 1 and 2 above)

Likewise, there is a solution if one-half of the number is itse an even number. For example, how would one write 36 in consecutive integer fashion? One-half of 36 is 18 so we cannot use the above method. However, following is one possible solution:

1. Take one-third of the number, e.g., in our example 36 - 3 = 12;
2. Then add to 12 the numbers just below and just above, i.e., 11 + 12 + 13 = 36.
3. For instance, 12 = 3 + (4) + 5. (4 = one-third of 12 as shown in step 1 above)

Using the above ideas, which numbers, like 9 in the example at the beginning of the article, can be split up in more than one way?

The answer follows:

Numbers that are a multiple of 3 and numbers that are a multiple of both 3 and 2, when one-half of the number is not an even number. For example:

1. 9 is a multiple of 3 and can be done 2 + 3 + 4 or 4 + 5;
2. 42 is a multiple of both 3 and 2 and one-half of it is an odd number, so it can be written 9 + 10 + 11 + 12 or 13 + 14 + 15;
3. But how about 12? It is a multiple of both 3 and 2 but one-half of it is 6, an even number. Thus, 12 can only be done as 3 + 4 + 5;
4. How could you do 81? 40 + 41 or 26 + 27 + 28.

Using the above ideas you might try to solve the following problems.

1. Are there numbers which cannot be written in consecutive integer fashion? What about 2, 4, 8, 16, 32, 64? What is the next number that could not be done?
2. How would you do numbers like 20 and 40? They are numbers whose one-half is even (as with 36 above) but whose one-third is not a whole number (unlike 36 above).

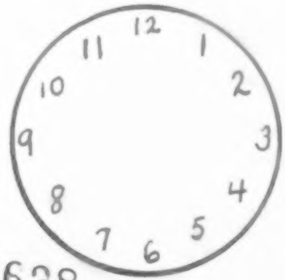
TIME OUT

Joyce Liniger

Draw a line across the clock face dividing it into two sections such that the sums of the numbers in each half are the same.

Make three sections with equal sums.

Can you make 4? 5?



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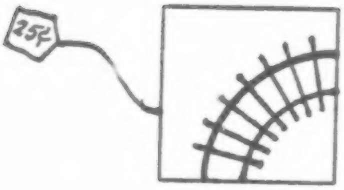
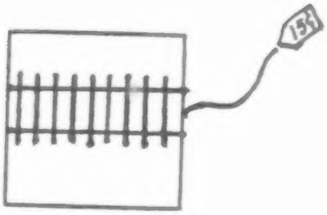
Build A Railroad

Lisa Krysalka





If you could buy an unlimited supply of each of these cards (curved 1/4 turn rail section and straight rail sections) and if each railroad system has to be closed (a train can go round and round it):

Make a track worth $1.35.

Using 32 cards make a track that costs as much as possible.

Using 27 cards make a track that costs as little as possible.

Etc., etc., etc.

Adapted from an idea in Heath Mathematics Problem Solving by George Immerzeel and Earl Ockenga.

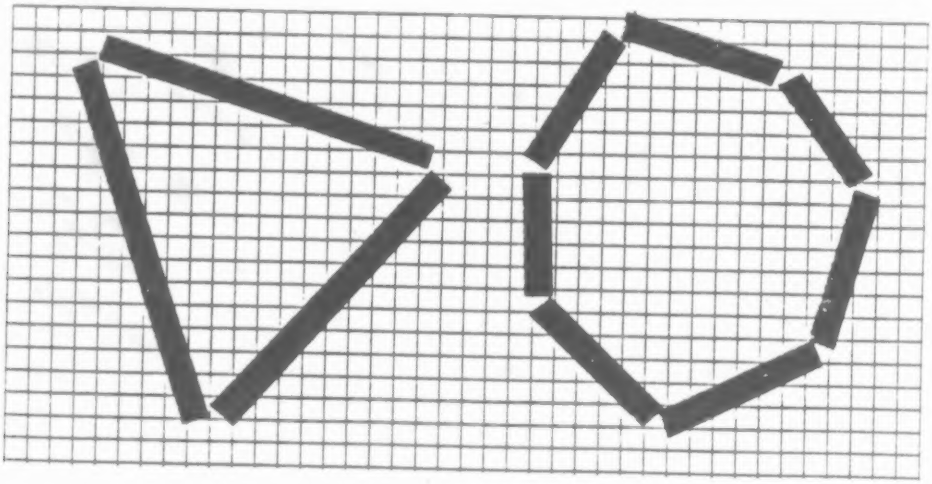
A FENCE AROUND SPACE

Brenda Wolf

What two dimensional shape with a fixed perimeter produces the greatest area? Students can explore fundamental geometric concepts and figure out the answer to this question through a simple project (from The Measurement Book, Enrich).

Materials needed are drinking straws, construction paper, glue, scissors and dried lima beans. Give students two rigid plastic straws each. Ask them to construct any closed geometric shape they wish, by cutting and gluing their straws (using all of both straws) to a piece of construction paper to create a fence for one layer of lima beans. Students fill their shapes with beans and count how many will just cover it. Then give students two more straws; ask them to construct a different shape by cutting their straws and gluing them to another piece of construction paper. Have students repeat this process several times, and then discuss which shape encloses the most beans.

Note - This might more profitably be done on squared paper - counting squares instead of lima beans.



MENTAL IMAGERY

Helen L. Miller

Recently, a parent asked me how he could help his son develop a mental picture of quantitative numerosity. He explained that his son was in the third grade and that the boy still had to use manipulatives (his fingers) in order to do mathematical computations.

I thought that this was a very important question that must be addressed. Ginsburg and Opper suggest that "physical experience which is essential to development involves actions which abstract or extract the properties of objects and events...Logico-mathematical experience is not the direct result of perceiving objects but of reflecting upon actions performed on objects."

Developmental learning "involves acquisition of general thought structures which apply to many situations." The concept of fiveness which a child must have in order to acquire computational skills has to be firmly established internally. Abstract concepts should not be introduced until a child has had a sufficient amount of time to manipulate concrete objects - blocks, cookies, fingers, etc.

Young children are astonished by their own ability to "count with their eyes shut!" The activities which follow can be used with children at all levels to help them develop and perceive mental images.

A child who has had experiences in constructing mental pictures will have something upon which he can build more complex ideas about numerical concepts.

"What can you see with your hands?"

Each child needs a stick of clay.

Each child must knead the clay until it is soft and pliable.

Can you make a ball?

Can you make a box?

Can you make your box longer?

Can you make your box higher?

Have the children work with the clay and ask them to describe what the clay looks like each time they change the shape.

When the children are familiar with the various shapes they have made and with the words needed to describe each different form, have them make the clay into a ball once more.

This time each child must close his eyes as he is shaping the clay into a ball.

Tell me about the clay now?

Use all the words you know that will help us see your ball of clay with our eyes closed.

Give each child a turn to describe his ball of clay.

Now, let´s trade balls of clay with a friend.

Keep your eyes closed.

Each child should have a turn telling about his friend´s ball of clay.

Is this ball the same size as yours?

Is this ball as round and smooth as yours?

Tell us about the ball.

Have the children open their eyes after each has finished his turn so that he can verify what he saw when his eyes were shut.

Repeat the same activities each time the shape of the clay is changed.

When all the shapes have been used ask the children to take the clay and to once again make it into a ball. This must be done with their eyes closed.

When each child once again has made the clay into a ball, collec all the clay balls and arrange them on the chalk rack.

Each child must now try to find the ball he has made.

Discuss what happened, or what didn´t happen.

"Teacher, I can count with my eyes closed!"

(Each child needs a stack of 10 buttons.)

Let´s all say the number´s names with our eyes closed.

1,2,3,4,5,6,7,8,9,etc.

(Say the number names until all the children have reached the limit of the number names which they know.)

Now, let´s open our eyes.

Let´s say the number names from 1 to 10 with our eyes open.

Let´s say the number names from 1 to 10 with our eyes open, but we are not going to make any sound.

(Articulate the number names, but do not make any audible sound.)

Let´s do this again. This time pretend to pick up a button and put it in a box each time you say a number name.

Are all the buttons in the box?

How many buttons do you have in the box?

Now we are going to close our eyes and pretend to put each butto in the box.

Say a number word each time you put a button in the box.

How many buttons did you put in your box?

Take all the buttons out of the box.

Close you eyes and let's pretend to put the buttons back into the box. Say a number word each time you put a button in the box.

Open you eyes for a minute.

Take all the pretend buttons out of the box.

Close your eyes. This time we are going to put the buttons into the box as we say a number word.

Do not say the number word out loud.

When you have put all the buttons into the box, open your eyes.

"Let's say the number words from 1 to 10."

Let's say the number words from 1 to 10 with our eyes closed.

Let's say the number words from 10 to 1 with our eyes closed.

Let's say the number words in this way - say number 1, do not say number 2, say number 3, just think number 4, etc.

Let's try it.

This type of activity can be varied in many ways as follows:

1. Say the odd number words; think the even number words.
2. Say all the number words from 1 to 10, except the number word that tells how old you are.
3. Say the even number words; think the odd number words.

"Guess what number (letter) that I am thinking of."

Each child chooses a partner. One of the children sits behind the other.

The child in back thinks of a number or letter from 1 to 10.

He must use his finger to draw that letter or number on the back of his partner.

The child sitting in front must guess the number or letter the child has written on his back.

Each child has as many guesses as his partner agrees to.

The drawer may repeat his letter or number as often as necessary in order for the other child to discover the answer.

When the number or letter has been guessed, the children reverse positions and repeat the activity.

This also may be done using short words, mathematical problems, geometric shapes, etc.

Let the children find other ways that the game may be played.

"Teacher, I have the wrong film strip!"

In my classroom I have a SVE series of film strips and tapes that we use to learn phonics. The material is quite good; the tapes are very descriptive.

As a way to help children make their own mental images, I set up the film strip projector, screen and tape recorder as usual, but I informed the class that there was no film strip to go with the tape that we needed to use. They would have to make their own pictures b closing their eyes and listening closely to what was being said on the tape.

Many children were very sure that they could not see with their eyes closed, but they began to slowly understand that they could make pictures in their heads by listening to what the narrator on the tape was saying.

(This was the moment when a small voice arose from the group stating that he had the wrong film strip! I asked him to use the one that the others were using and he promptly complied!)

This is an activity which can be repeated, using different tapes, records, or having the children take turns telling a story which they have made up.

"Play Ball!"

It's such a nice day that we are going to go to the park to play ball.

Let's close our eyes in order to see the ball.

I have a great big red one.

What color is yours, Jimmy?

Mary, did you bring your yellow ball?

There's Mark; he has a green ball.

Let's throw all the balls up into the air.

What ball went up the highest?

Mary, I see yours over there.

How many balls are there?

Here comes Joey; he wants to play too.

How many balls do we have now?

Let's put all the balls on that wall.

Which one is the first one in the line?

Which one is the last one in line?

If I push the last one, what will happen to the others?

(This story can go on as long as the children are interested. Each child should suggest something that can be done with the balls.)

The skills developed by these activities enable the children to do manipulations in their heads - they can actually visualize the problem and its solution.

FOLD A SHAPE

Fredrica Walker

The following activity is one that I did with second graders. The children seemed to thoroughly enjoy this. I found this to be an extremely useful activity for teaching shapes and sizes in a hands-on approach.

Materials: white paper, crayons

Procedure:

1. Instruct students to fold a piece of paper several times. (I would demonstrate.)
2. Allow students to then unfold the paper.
3. Using the fold lines as boundary lines, ask the students to identify a figure with 3 sides. Have them color all the three sided figures the same color. (red)
4. Ask the students to identify all figures with 4 sides. Have them color all the four sided figures the same color. (blue)
5. Look for 5 sided figures. Color these shapes all the same color. (green)
6. Continue this activity depending on the number of sided figures the students have.
7. Allow the children to show their creations to the class. Good discussion opportunity here.

My students had primarily triangles and quadrilaterals. The coloring of the figures enabled the children to see not only the number of sides in each shape, but the various sizes of each shape.

This idea could be expanded by allowing the children another opportunity to fold a new piece of paper. This time ask them to fold it differently and compare the new kinds of figures made with the first effort. Look for similarities and differences in shapes.

Editor's note: After several folding experiences ask the children to fold a triangle, square, quadrilaterals, pentagon, etc. What conditions must be met for each shape?

The idea for this activity came from Level II Mathematics published by Scott-Foresman.

THE BEAD STRING

Virginia Small

"The bead string is an answer to a prayer. The period when children first do simple arithmetic computations is a crucial one. They are now supposed to get answers, lots of them, and have them right. Their worth is suddenly and really being tested. It is a period (for many school children) of finding that they are not O. K. The pressures on them are too great. Yet is it not now that they must begin learning sums? No, far better keep their sense of worth." These statements are by Hassler Whitney in his book, Elementary Mathematics Activities .

The bead string has been "an answer to a prayer" in my classroom. I was first introduced to the bead string at the Teacher´s Center. I decided to try them in my class and I have been using them since that time. I began with strings of 20 beads changing color every 5 beads. This year I have introduced bead strings of 100 changing colors every 10 beads. At parent conference time I introduce the parents to the bead strings and encourage them to have some at home. These are available at all times for counting.

The variety of activities with the bead string is limitless. Hassler Whitney tells us, "But the realities of life are that they will be expected to do sums. If this can become constructive for the children, how fine that would be! What they need is a simple tool to help them find sums; but not just be told the sums. It should help them see the why of sums, so that with growing understanding, they can then find the sums themselves without tools. The tool should be an extension of themselves; simple, durable, easily kept, and if possible made by themselves. The bead string has all these qualities.

No matter what kind of math program the children may be in, the addition of the bead string to it can work wonders in getting the kids moving successfully."

Bead strings can be used individually or with a group. Some group activities can be, find 7 with you beads. Add 5 more. What patterns do you see? Take away 2. Tell me what you see. Show me 5, now 10, now 15. Tell how you find these numbers. If you have 7 cookies and ate 3 of them how many would you have left? Show this on the bead string. Jim put seeds in the bird feeder and saw 3 birds fly down to eat. As he watched 5 more came to eat. How many ate at the feeder? Show this on your bead string. Jim's bead string had 100 beads. The colors were blue and white changing colors every 10 beads. If the first 10 beads are blue what color will the 50th bead be? The 60th? What pattern do you see?

This problem solving takes time and takes thinking. Ed Labinowicz in his book The Piaget Primer tells "Piaget's view indicates that higher-order learning can only take place after some frustration has been experienced." "Thinking takes time...Children who progress the furthest are often those who were the most confused initially."

"Thinking through a problem takes time. Answers to real problems are not pre-formed in the children's minds. Rather, they are constructed by the children through active involvement with a problem. Yet classroom research indicates that teachers allow children less than one second to respond to a question.!

Try the bead strings you will like them. The children will too!

KNOWLEDGE

Peggy L. Nuernberger

Since objective knowledge of the world is not given and if the child's knowledge is not a copy of reality, how is sensory information transformed into knowledge? Knowledge is built from actions, experiences, and the interactions with the world. For example, if the child releases an object, it falls. The object might be returned and the same object is released again. The child begins to construct a notion that flexing the palm leads to the object's falling and that grasping leads to its retention. In this process, the child is an active participant in constructing a mental picture of the physical and social environment.

Looking at human beings in this fashion clearly reveals that they are not passive organisms moved about by forces beyond their control. Rather, they are active, modifying the environment. Humans engage actively in the transformation of their reality. This perspective clarifies the role that action plays as a human development.

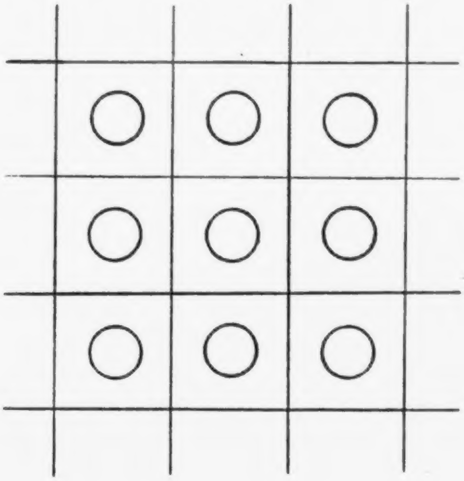
Constructivism refers to that process of constructing, in effect, creating a concept which serves as a guideline against which objects or people can be gauged. During the course of interacting with objects, people, or events, the individual constructs a reality of them. The object, for example, is defined mentally. This mental construction then guides subsequent actions with that object or event. For an example, knowledge of the object orange is built through actions and reactions of that object until a contruction of an orange results and we know the orange. This knowledge of orange influences subsequent interactons. Construction of objects, their characteristics and their place in the scheme of things is an outcome of direct and indirect contact with these objects. Not only is the concept of constructivism appropriate for construction of knowledge of physical objects, but it can be used as a generic concept identifying a process by which reality in general is systematized and ultimately schematized.

CHIPPER CHECKERS

Tracy Schmitt

Chipper Checkers will allow children to develop their thinking ability. They can play individually or make adaptions to play with a partner.

Chipper Checkers is a 3 x 3 array of chips. Children are to jump one chip at a time removing the jumped chip. Outside boundaries can be used. Every move must be a jump and the jump can be made in any direction. The goal is to be left with only one chip.



MAKE A MYTH

Lynn Blockyou

In social studies we were studying ancient Greece and discussing gods and goddesses. One student asked how the ancient Greeks could have such a "silly" religion. I decided to skip the lecture about "what we believe might have been laughable to the ancients" and thought we might understand better if we made our own myths.

A. Role Playing
- imagine yourself in an ancient land
- discuss your home
    - your family
    - your clothing
    - your possessions
    - your living
    - what is important to you
- what things might frighten you
    - thunder
    - volcanic eruptions
    - eclipse of the sun
    - etc.
- how might you explain these events

B. Greek Myths
- discuss the myth of Demeter and Persephone

Demeter is the Goddess of Agriculture whose daughter Persephone has been kidnapped by the God of the Underworld. Since Persephone ate while in the Underworld (6 seeds), she must stay in the Underworld for half of the year. Therefore, her mother weeps and is unhappy for the 6 fall and winter months. The snow and sleet are her tears. For the 6 months that Persephone is able to live on Earth, the sun shines, crops grow, trees are green, and everyone is happy. These are the 6 spring and summer months.

- discuss what moral values are here
    - what natural events are explained by this myth

C. Can you make up a god

D. Can you think up a story about him

AN EDUCATIONAL VIEW OF THINKING SKILLS

Jim Kessinger

Educators often view the development of thinking skills in the realm of enrichment, fun time, or merely brain teasers. Not unworthy in their own right, thinking skills do have a more urgent purpose.

The ability to reach decisions based on experience and present knowledge has been mankind's claim to a higher order of existence since the beginning of time. Free people around the world respect the thinking skills of their fellow men. Consider the renowned men of philosophy, science and the fine arts. People the world over hold in high esteem those who can reason. No one would argue with the statur of an Einstein, Edison or Henry Ford in terms of an ability to successfully solve problems and thus contribute to the betterment of mankind.

At this point a tragedy in American education reveals itself. While recognizing the desirability of thinking skills, we often measure success in education by one's ability to memorize and recite facts - which hardly seems to be the answer to the problems facing our technology-oriented society. An alleged conversation involving Alber Einstein illustrates the error of our way. When asked how many feet in a mile, Einstein replied, "I don't know. Why should I fill my brain with facts I can find in two minutes in any standard reference book?" (1) We must be aware that it is far better to use our mental ability to create and make history than it is to simply record the history make by other men.

Schools would be well advised to look at the evidence currently available on the need for people who are highly capable of memorizing facts. Without exception, the successful person who knows how to get information is of far more value than the person who simply uses his mind as a warehouse for facts. In other words, the trivia expert, as we might call him, is easily replaced by a $2.00 almanac or a computer. The school curriculum must seek to develop thinking skills as the intricate fiber of a child's daily program. Parents, teachers, and administrators must demand that all forms of media used in schools recognize and provide for development of the thinking process.

A word of caution lest we conclude that thinking skills are only for the gifted student. It must be a guiding philosophy that anything can be taught in an intellectually honest fashion to anyone. Thinking processes or thinking skills are a vital component of a fulfilled life regardless of academic status. All people involved with children's learning must learn well the lesson which says, "achievement is based as much on stick-ability as ability." In short, "The mind of man is organic. Casual observation alone is sufficient to show that the 'memory bank' view is inappropriate: we dream, we imagine, we predict, we wonder, we invent. We generate problems and we solve them without having first memorized a handed-down solution." (2)

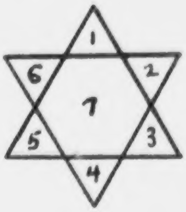
Such a view is characteristic of all humanity. The preceeding statement makes no differentiation among those who have greater or lesser abilities. All humanity engages in the day to day effort toward identifying problems and establishing solutions. Thus, the thinking that guides our intelligence is far more important than our brain power. It definitely behooves our schools to develop the total population and not those few with a high degree of innate intelligence.

1. David Schwartz, The Magic of Thinking Big . Englewood Cliffe, NJ: Prentice Hall, Inc. 1959.
2. Thomas C. O'Brien, Quarterly Journal of Piaget Society: The Genetic Epistemologist. College of Education, University of Delaware.

TRIANGLES

Joyce Liniger

These two triangles make 7 sections.



Show how two triangles can make:
6 sections, 5 sections, 4 sections, 3 sections

Show how two rectangles can make:
3 sections, 4 sections, 5 sections, 6, 7, 8, 9

There are several ways to show the answer for each exercise. Students could experiment with paper triangles to find different patterns.

PLAY AROUND WITH PALINDROMES

Maggie Burhite

A palindrome is something that is the same when read forward or backward. Words can be palindromes. Example - Anna, radar, noon. Can you think of any others?

By reversing, we can make numbers into palindromes.

Examples:

63
+36 (one reversal or step)
99 palindrome

628
+826
1454
+4541 (two reversals or steps)
5995 palindrome

206
+602 (one reversal or step)
808 palindrome

356
+653
1009
+9001
10010
+01001 (three reversals or steps)
11011 palindrome

Try these numbers - record how many steps or reversals it takes to make them palindromes. (Be prepared - it may take quite a few steps.)

54 79

264 483 673

117

Now make up some of your own. Record your reversals (steps). Have you found any numbers you can't make into palindromes? If so, can you figure out why you can't?

RESEARCH FOR YOUNG CHILDREN

Wanda Schroeder

Near the beginning of the school year, ask your students to think of ten things they would like to know about their classmates. You may offer suggestions such as: the number who ride the bus to school, those who live in town, how many have a pet or other things of interest to your particular age group. When they have determined the ten things they would like to know about the class, have each child prepare a questionnaire for each of his classmates to fill out. To avoid confusion only two or three questionnaires should be distributed at a time. When all of the children have collected their information, instruct them to total the number under each of their ten categories.

The results of this research can be shown on bar graphs. Each child may chart his or her results on a sheet of graph paper in a manner similar to the one shown.

These bar graphs can be displayed and the information shared and discussed.

BOTTLE CAPS INCORPORATED

Virginia Small

"There is no need to wait until a large collection of equipment is made. Many teachers have found that children are anxious to help collect materials when they know what is needed. This serves a dual purpose; it helps make the children feel that they have an important role in the development of the program and encourages them to be alert to the mathematics that is a part of their environment."

This statement from Freedom To Learn by Edith Biggs and James MacLean was taken to heart by our class as we began our collection of small bottle caps. The children were eager to share in the collecting of quite an interesting variety of textures, shapes, colors, and sizes of bottle caps.

Our collection is placed in plastic five quart buckets which are easily carried to the rug or desk to be examined, counted, or sorted in a variety of ways. The children are given time to handle and play with the bottle caps to see what interests would develop. "I brought this many bottle caps!" said Erin. With this remark she scooped out a handful of bottle caps onto her desk. "These look like the ones I brought." Jennifer stated. "Each of you take a handful" I suggested "and try to guess how many you have." "My pile is the biggest." replied Erin. "Mine looks bigger than yours." remarked Jim. "I wonder how many are in the whole bucket?" Jennifer said as she watched the others.

Some of our greatest insights about children come from really listening to their conversations as they work. It helps to remember Albert Schweitzer's statement that "Only those who have respect for the opinions of others can be of real use to them. Do we as teachers show respect for the children by our reactions to answers that do not fit our preconceived adult expectations? A child never gives a wrong answer. Every problem response that he makes is right for him on basis of his present knowledge and background of experiences."

Thus our adventure into the real world of bottle caps began. Here are a few suggestions -- try to think of more.

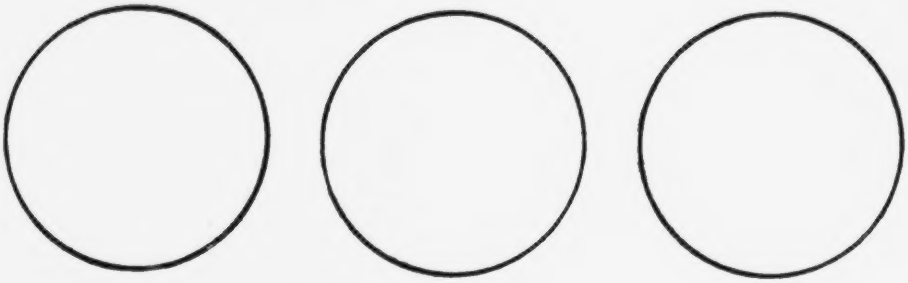
1. Take a handful of caps and put them in a pile. Take another handful and put them in another pile. Which pile has the most? How can you tell?
2. Take a handful of caps. If you were to place them in a straight line how far would they reach? Try it!
3. Take 10 caps and see how many different shapes you can make? Did you use all ten?
4. Take 9 caps and see how many shapes you can make? Did you use all the caps each time? What can you share about your shapes?
5. Take a small box (about the size that checks come in). How many bottle caps do you think it will take to fill the box? How can you find out?
6. Choose 5 caps and make up a story about the caps.
7. Use both hands to scoop out bottle caps. Can these all fit into one set? How many different ways can they all make one set? Can they all fit into 2 sets? How many ways can they make 2 sets? What are the most sets you can make?
8. Close your eyes and choose 5 caps. Feel the caps and tell if you think they came from a container that held a liquid or something dry? Try to guess what the product was.
9. How many caps do you think you can stack before they would fall over? Were you right? How was your estimate?
10. What is the most popular color of bottle caps? Is this color your favorite color?
11. How many different textures do you find in these bottle caps? Why are they different? Which do you like the best? If you were in charge of making caps what would you consider before making them?
12. Some of the caps have prices on them. Do you think these cost a lot? How can you tell if they cost a lot? What would you have to consider?

Counting and classifying are not trivial issues. Ed Labinowicz states in his book The Piaget Primer "A significant number of six yea old children have demonstrated the ability to classify three-dimensional objects, yet they are incapable of comparable classification when presented with two-dimensional photographs of the same objects. Some textbook authors have incorrectly assumed an equivalence between objects and their pictorial representations that would allow children to make instant translations. From Piaget's theory however, we see that only a rich variety of experiences with objects leads to mental construction of the object and its relationships. Later, these mental constructions can be triggered by pictorial representations."

Our bottle caps are the beginning of some rich experiences with objects that are a part of our world of today.

Many Ways To Cut A Pizza

Lisa Krysalka



Cut a pizza into three pieces using 2 straight cuts. What if the pieces must be of equal size? How many pieces can you get if you use 4 straight cuts? What is the largest number? The smallest? What if the pieces have to be the same size? How about 3 cuts, 5 cuts, etc.?

Adapted from an idea in Heath Mathematics Problem Solving by George Immerzeel and Earl Ockenga.

PROBLEM SOLVING ACTIVITIES FOR YOUNG CHILDREN

Ann Turvey

Game 1 - How Many?

Ask any questions that call for problem solving, particularly questions that allow for a variety of possible answers. For example: "How many ways can you think of to get to school?" "How can you get from one side of the room to the other without walking?"

Game 2 - How Can I? How Can You?

Ask the child a question on how to solve a simple problem. "How could I(you) play the record player if it were on a high table and I(you) were too short to reach it?"

Game 3 - Which?

Similar to the above game. Often the first question you ask is which? and this is followed by the second question why? Select questions that involve judgment or opinion. "Which of your games do you enjoy playing most? Why?"

Game 4 - Why? or If?

This time ask questions that start with why or if. Such as, "Why do cows live in the country?" Let´s think, "What is it that cows eat?" "Is there much grass in the city?"

Game 5 - Sequence or Which Comes First?

Show pictures depicting an event showing before and after to see if the child can identify the sequence. Progress to a story sequence or series of three or four pictures. Ask the child to reorder and give reasons for choices. Some pictures might be reversible: clean/dirty, or chicken/egg.

ESTIMATING WITH STRING

Maggie Burhite

Have children find a partner - give each pair several pieces of string in varying lengths, and a ruler.

Each child chooses one piece of string which they form into any shape they wish. The children then look at each others' shapes and try to estimate the length of the strings.

1. Write down your estimate
2. Measure the string
3. Write down the actual length of the string

Repeat this activity until all the pieces of string have been measured. Ask the children if their estimates became more accurate as they went along. Did the shapes you made change as you went along? Which shapes are hard to estimate? Which ones are easier?

NINES CANCEL

Don Larson

Vacations are the times we remember through pictures and memories. Unfortunately, some of those memories include long, boring drives. My memories include my mother leading us in songs and playing games as we went on down the road.

Since I spend many hours on the road, I've developed a game I call "Nines Cancel"! Since it is hard to manipulate objects in a moving car, one should be aware of the abundance of game tools passing every minute - namely license plates. The game began by counting how many states or countries I could find on a certain trip (27 is my record for a Chicago to St. Louis trip).

The next step was adding the numbers until only one digit remained. For example, XS2334 would be added (2 + 2 + 3 + 4 = 12) (1 + 2 = 3). That plate is a 3 plate. The object became to find a 1 plate. The plate XS2332 would be such a plate (2 + 3 + 3 + 2 = 10) (1 + 0 = 1)

After many hours of playing this game, I noticed I wasn't adding in nines, I was cancelling them out, then adding. The plate XS9329 would work as (9 + 3 + 2 + 9 = 5), since (9 + 3 + 2 + 9 = 23) (2 + 3 = 5).

More advanced players can cancel numbers that add up to nine (8 + 1, 7 + 2, etc.). The plate 981364 would work (9 + 8 + 1 + 3 + 6 + 4 = 4). The only time you can't cancel nine is when it is the only number. The plate XS45 is an example of that, (4 + 5 = 9). The reason is because the original rule was to add all numbers, and by adding numbers you can't get zero. I thought the numbers one through nine were the only answers you could get until I recently came across the plates BAR-0 (Bar None), HALF PINT (1/2 pint), and the Texas plate 00 RANCH (Double Zero Ranch).

On your next trip, try these variations of the "Nines Cancel" game, or try some of your own. Have fun!!!

MONEY AND DICE GAME

Mary Ann Sommers

Playing this simple game will provide practice in making change.

Material: Dice and Money - The amount of money used and the kinds of coins will depend on the number of children playing the game and the value to win the game.

Procedure:

1. Two or more children can play.
2. First player rolls two dice and receives the amount rolled in cents.
3. A player can NEVER have more than 4 pennies.
4. All coins MUST be exchanged for higher value. Example: First roll is 4; player receives 4 pennies. Next roll the same player rolls 2 and receives 2 pennies for a total of 6 pennies. The 6 pennies MUST be exchanged for 1 nickel and 1 penny at this time.
5. Teacher must keep an eye on this game at first or a child playing the game must know how to make change.
6. First player to reach 25 cents or value determined before starting the game wins.

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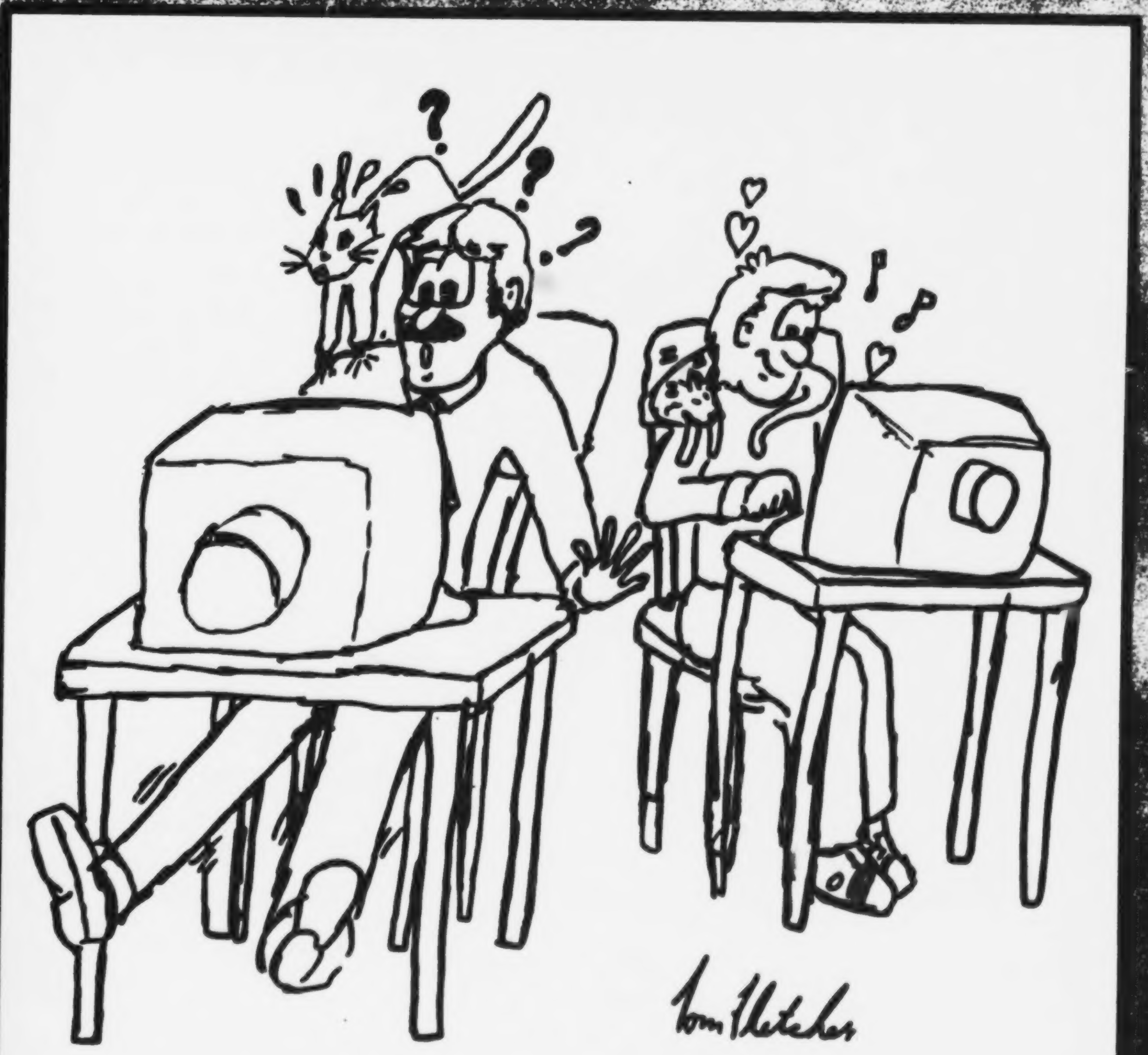
SEEDBED

COMPUTERS IN EDUCATION


Tom Fletcher

SEEDBED

COMPUTERS IN EDUCATION

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SIUE

Southern Illinois University
at Edwardsville

1658

INTRODUCTION

Here comes another educational bandwagon -- computers.

Educators nationwide are jumping on the bandwagon. "What computer should I buy?" "Do I need 48K or 64K or 128K?" "Which is better -- Atari, Apple, IBM, or TRS-80? "Should we go to Corvus disks or not?

What I see is a nation of school administrators, as has been so commonplace, chasing yet another rainbow. Committees meet, hardware is purchased, machinery is delivered, and business proceeds as usual (often with the newly purchased computers sitting unused in closets).

We cannot persist fruitfully with a "How do we get there?" mentality. American educators seem constantly to ask "How do we get there?" without first asking "Where is it that we want to go?" American education to often succumbs to bandwagons promising rapid delivery.

Are micro-computers becoming popular in schools because they promise rapid delivery? Delivery of what?

Several things are clear to me so far as education and computers are concerned:

1. It's all too easy to let technology rule in one's educational decision-making. That's backwards. Rather, we should square away our educational act -- including the setting of goals -- and only then enlist technology as a rich and versatile resource.
2. If computers are to be a resource in education -- and there is no doubt that they are fabulously rich resources -- teachers

must get in on the act. To parachute new technology into classrooms without teachers' active participation and decision-making, as modern math was parachuted in the post-Sputnik era, is to insure that computers will be yet another fad; i.e. good public relations for school administrators and no payoff in terms of lasting improvement of education.

3. The availability of computers may mean that we should re-think goals in education. When only horses were available, Americans could reasonably contemplate a ten or twenty mile trip. Once automobiles became available, a two hundred mile trip was possible, a ten-fold increase. It is clear that the availability of computers means that we can go much further, educationally, than we have in the past. It also means that there's a great deal of chaff in the present curriculum which, now that computers are here, needs to be sifted out. The cheapest microcomputer can do arithmetic computations, for example, faster than one's eye can follow the answers. Should we continue to give eight years of children's mathematical education to speed and accuracy in arithmetic computation?

Yet the question remains. Will computers be yet another fad in education?

The answer is both Yes and No.

There is no question but that computers are a major part of American society (unlike previous bandwagons such as ITA or modern math) and that they are here to stay. If you doubt this, drop in on an Arby's or an airport tower or a stockbroker and see what computers can do. Or pay a visit to your local Users' Group see what's growing up around you. That is to say, we are part of the computer age, no doubt about it.

On the other hand, it is not clear that American education will go far in making use of computers. Major publishers are translating their textbooks into glittering computerese, a sorry blessing at best because the textbooks are so dismal in the first place.

Much of the software that's available to educators is straight drill-and-practice stuff, just like the curriculum itself. To enlist a powerful tool such as the computer in the service of outdated educational practice is foolish at best.

Most of the local vendors I know are content to peddle iron. They have no interest in or knowledge of educational software or educational uses of computers.

So here we are again, racing after the illusion that parachuted stuff will solve educational problems.

Fortunately this time there are widespread grassroots efforts in the interest of improving education through computers.

For example, there are groups such as MECC and CUE which involve and inform teachers and which provide low-cost software, much of which is exemplary.

And there are journals such as Classroom Computer Learning and Computing Teacher and Electronic Learning which have an interest in kids and their growth rather than in technology for technology's sake.

And there are publishers such as Sunburst, Spinnaker, Conduit, The Learning Company, Broderbund, Children's Computer Workshop and others 1) which see children's learning as active construction rather than passive copying and 2) which publish rich investigations and activities rather than full-blown carbons of the present deadly curriculum.

But perhaps most important, there are large numbers of teachers and parents -- educationally potent for perhaps the first time -- who are rolling up their sleeves to harness the incredible power of computers in thoughtful and caring service of children's growth.

This special issue SEEDBED was put together by teachers participating in the Teachers' Center Project's summer 1983 course on computers and education. It is a grassroots effort and much of the frustration and excitement and caring and high-quality thinking of the participants is evident in their work.

Special thanks to Marge Kosel, Computer Director for Sunburst Communications, who conducted part of the course and contributed an interview to SIUE's National Public Radio station. Special thanks also to Liza Loop (Loop Center, Palo Alto), who worked with SIUE area teachers in spring 1983 and whose forward-looking views are expressed in an interview with Teachers' Center participant, Mary Steffen.

We think that this special issue of SEEDBED will be a rich resource for other teachers who are at an early stage of engaging computers as an educational ally. Let us know your reactions as you read and engage what educators, not technicians, say about computers and education. Let's enlist computers richly in the service of children's growth.

Shirley A. Carey

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ABOUT THE COVER

The art on the cover of SEEDBED 17 was done by Tom Fletcher, a student at Ferguson Middle School. He's a former student of Teachers' Center oldcomer Mary Steffen.

FIVE ESSAYS ON COMPUTERS IN EDUCATION

Thomas C. O'Brien

This article appeared in the October 1983 issue of Phi Delta Kappan. Other articles by O'Brien concerned with computers and education appear in the September and November issues of Classroom Computer Learning.

Two years ago I was scared to death of computers. My field is mathematics education and the intellectual development of children. I had used an IBM mainframe to process data for my doctoral dissertation in the Sixties -- vivid memories of computer tape unfurling on the floor at 3 A.M. recur as I write -- but I had had no user friendly experience with computers and no experience whatsoever with microcomputers. Two years ago I was certain that there were dragons inside those micros and if you touched the on/off switch, the dragons would leap out and devour you.

Young Tom came home from college on Christmas holiday two years ago and I asked him if it might be possible to put some children's games into computer format. "Easy," he said, and he graciously spent much of his Christmas vacation programming in Applesoft. He had finished about two thirds of the job when vacation ended. "I'll do the rest when I'm home at Easter break," he said. Impatient to finish the work, I cannibalized what Tom had done and, oops, I became a computer programmer.

My progress was incredibly slow. I remember thinking a friend a genius when he added a simple bell to a program I was writing. I can easily remember the whole day I spent "programming" (a pretentious word to describe what I was doing at that stage), only to turn the machine off without having typed SAVE. Result? A day's work down the electronic drain.

I can remember SAVEing on both sides of a diskette and coming away with electronic spaghetti when the signals bled through. And I can remember the month of utter anger I went through --

I was even more impossible than usual to live with -- when every event was a snarl. It dawned upon me just this side of a psychiatrist's couch that my month of anger was caused by my trust in that inert machine called micro. Two people can have a conversation and one can mispronounce a word and the other is likely to make sense of what was said. Or one person can write to another and misspell a word, and the reader will cope. But that stupid machine had no tolerance of ambiguity. It wouldn't take a semi instead of a colon. It wouldn't take a RUM. It didn't remember to SAVE, even when SAVEing was the most important act of the day. At the end of that inglorious month I realized that it was the machine who was stupid and I who was smart and my life returned to normal.

What I am saying, somewhat indirectly, is that I am relatively new to microcomputers. I am also saying that I am not a technician and still wear proudly the stripes of an educator. It is as an educator who is newly friendly to computers that I write what follows.

1. Let me try to sell you an automobile. "The door handles are easy to find. The owner's manual is in the glovebox. The gear positions are clearly marked (R/P/Drive/2/1) and the speedometer dial glows in the dark." Will you buy my car?

I hope that you'll say "NO."

My point is that I have been to dozens of sessions on "Evaluating Computer Software" where the main concern seemed to be that the software should be 1) user friendly and 2) well documented, if possible with laundry lists of behavioral objectives.

My point is that there is a more important issue. As the car I was trying to sell you, the software should go somewhere. My car-for-sale was user friendly on the surface but you might have been wise to ask if it had an engine. Otherwise, it would not go somewhere.

Educational software should go somewhere, not simply be well documented, easy to access, grammatically correct, and so forth.

What does it mean to go somewhere?

It does not mean, I submit, using classroom computers to teach arithmetic computation to children at a time when computers themselves can perform a hundred million long multiplications (for example) in one second. To do so is to use Henry Ford's motorcar to teach horse-shoeing, if such were possible.

It does not mean committing rote connections such as Denver/Colorado, Cheyenne/Wyoming, and Albany/ New York to memory. Much of American education is given to memorizing such static connections (or combinations of connections, such as the rote procedural steps of long division). To focus on static knowledge is to demean people and especially to demean children. People are much more than memory banks for static facts. They organize reality, not just store it, and their organizing tends toward economy, stability, coherence and generalizability.

So what does it mean to say that educational software (and education in general) should "go somewhere"? Such a question is rarely asked but it must be the first question that is asked and and it must be constantly asked. We all too often focus on means instead of ends. We all too often ask "How should we get there?" when the more important question is "Where are we going?"

One major goal of education, and therefore of educational software, must be the development of intelligence. What is intelligence? Here is one description to which software developers might attend:

> The essential abilities for intelligence are certainly:
>
> to respond to situations very flexibly;
>
> to take advantage of fortuitous circumstances;
>
> to make sense out of ambiguous or contradictory messages;
>
> to recognize the importance of different elements of a situation;
>
> to find similarities between situations despite differences which may separate them;
>
> to draw distinctions between situations despite similarities which may link them;
>
> to synthesize new concepts by taking old concepts and putting them together in new ways;

to come up with ideas which are novel.(Note 1)

This, I submit, is going somewhere. It is the development of intelligence that education is all about. We must not confuse clear documentation of educational software and computer friendliness with educational quality.

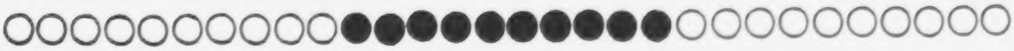
2. One of the major distinctions to keep in mind when one thinks about the role of computers in education is the difference between static knowledge and dynamic knowledge.

Imagine for a moment a situation where children memorize their addition tables. Think of children chanting and writing, over and over, 6+7=13.

I have no doubt that such children, when asked "What is 6 + 7?", will answer "13". But I have substantial doubt that they will be able to relate their knowledge to real world entities (Note 2) or to 6+7 in a different format (say, vertical), and I know that many such children if asked about 6+8 will regard 6+8 as a new issue unrelated to the 6+7 they committed to memory.

Indeed, one of the most common complaints of teachers is that children return to school after summer vacation -- or even after a weekend -- seeming to have forgotten all they know. "We teach them," teachers say, "but they don't stay taught."

Now imagine a different situation. Here is a beadstring where the first ten beads are red, the next ten white, the next ten red, and so forth.



Locate 6 on the beadstring. Now count off 7 more. What is 6+7? It's the same 13 as above, of course, but here one constructs the 6+7. Many people think this way: "Six, get to ten, go three more." Now ask them "What's 6+8" and they'll say "One more. That's 14." They see the 6+8 and the 6+7 as intrinsically related, not as isolated atoms.

Static knowledge often amounts to a single response to a particular, fixed stimulus. "Colorado?" "Denver." "Wyoming? "Cheyenne." "New York?" "Albany." North Dakota?" "Oops, I forget." By static knowledge I mean knowledge which is obtained by copying -- from the teacher, from a book, from the next person. One copies static knowledge over and over again until one has it "letter-perfect." Static knowledge is knowledge that you either have or you don't; you cannot reconstruct it. It goes nowhere. In fact, it is often intended to be an end in itself, i.e. to go nowhere.

By dynamic knowledge, I mean a fabric of ideas which is obtained by action, rather than by copying. Dynamic knowledge is constructed by children (and by you and me) and it is easily reconstructed. (That is, if memory fails, the issue can be built up again.) Perhaps most important, dynamic knowledge goes somewhere; it leads to new knowledge.

If this is all too airy-fairy to the reader, let me point out that children world-wide have a superb command of their native language by age five or six. An immensely complex and wondrous achievement this is, one which involves construction, coordination, elaboration and differentiation of meaning and syntax. This is dynamic knowledge.

In brief, dynamic knowledge is a fabric of ideas rather than a storehouse of inert associations. It is dynamic knowledge to which educational software -- and education in general -- needs attend.

3. There are several welcome aspects to the increasing availability of educational software. And there are several dangers.

Among the welcome aspects are cost and production time. A textbook series -- and it cannot be doubted that textbooks ARE education in the U.S. these days -- takes an investment of millions of dollars and a commitment of many years to produce. On the other hand, a computer diskette can be produced in "manuscript" form in hours and its commercial production may take months at a cost of thousands, not millions, of dollars. What comparative risk-taking and flexibility this permits. And, one hopes, what quality and diversity!

Another welcome aspect of educational software is that educational innovation can become the concern of talented citizens from all walks of life, not the private preserve of a closed circle of educationists. (At least at this stage of the affairs, such an event is possible.) Need I point out that Maria

Montessori was a physician, Jean Piaget a biologist/philosopher, Froebel a chemist, Dewey a philosopher and Comenius a theologian?

On the other hand, there are certain drawbacks. The hand of the technician plays a rich and welcome role in computer software. Hurray for color and well-chosen graphics! But graphics can overcome the educational richness of software and one is left with mere glitter and buzzers and bells. Such is widely the case with software produced by some major publishing houses. What they have done is to take existing textbooks and translate them into computerese, complete with the best of buzzers and bells.

Recently I had the opportunity to take a long careful look at the basal texts in elementary school mathematics. The books, save for graphics and photos, could easily have been published a hundred years ago. Mathematically and psychologically barren, the books prepare children for a world which has long since ceased to be. (Note 3)

Should educational software emulate such textbooks? I think not. At the very least -- and at the most polite -- it is fair to suggest that there are dangers here. Offal served with whipped cream is still offal.

In general, I suggest that buzzers and bells and wondrous graphics are often welcome in educational software. There is danger, though, that a technician's magic can act as camouflage for educational emptiness.

4. A major role -- perhaps the major role -- of educational software is to allow teachers to do what they have always wanted to do but never got to do - at least to the level of their choice.

That is, software can enable schools and homes to promote children's thinking. (Note 4)

For example, the public domain programs of Willy and Jacqueline Vanhamme enable children to learn about probability, a topic often given lip service in textbooks and rarely addressed in the classroom (because there are so many "basics" to attend to). "Dice," available in Applesoft, enables teachers and children to simulate the tossing of from 1 to 6 dice from 500 to 1000 times. Further, the program tallies the data and draws a histogram of the actual and the expected results. No one sensible would doubt the importance of a knowledge of probability but few of even the most sensible teachers would be able to cope with thirty children each tossing six dice a thousand times.

Other examples of software which encourages complex thinking are "The Factory" (which promotes complex combinatorial thinking), "Gertrude's Secrets" (inferential thinking), and "Taxman" (the construction of numerical strategies). (Notes 5-8)

In general, a major role of educational software can be to enrich the lives of children by enabling them to address issues which teachers would like to, but rarely are able to attend.

But the availability of good software raises some major questions about the existing curriculum. A standard topic in school mathematics is graphing. (Do you remember graphing endless $y=mx+b$'s? I do.) "Functions," again by Willy and Jacueline Vanhamme, enables children to type in various equations (such as y=3x+5 or y=1/3x-5 or even y=x^3-x^2/13+x/7+9 and y=sin^2 (x/13) + (x^3 + 5) and the computer draws both the graph and the first derivative of the function. (Note 9) Now for the first time a child can learn in a few minutes the difference, say, between $y=3x$ and $y=3x-2$ or between $y=x$ and $y=x^2$ and $y=x^3$ without hammering out the coordinates point by point as we once did so painstakingly by hand.

In brief, educational software solves many problems for teachers by enabling them to do the things they always wanted to do. And it raises a question. A welcome difficult question. What's the wheat and what's the chaff in the present curriculum? In addressing such a question, we may come up with even more nutritious wheat.

5. There's one thing about which we all agree. Kids, especially little kids, are wonderful. Think of that little two year old. What a wondrous being he/she is! "How I wish I had their energy," say mothers and dads. "Wish we were their age again."

And there's another thing upon which most people agree. Computer freaks! Worse, teenage computer freaks. Dreadful! At computer arcades, they mindlessly plunge in their quarters without a "What-ho" to the world. At home they grunt "Hello" and disappear into their micro world for what seems days on end. What a dreadful state we are in!

My hunch is that the delightful two-year-old and the dreadful teenage computer freak are one of a kind. What makes the two-year-old so delightful is the same thing that makes the computer freak so dreadful.

The point is that the underlying glue that keeps us together is equilibrium.

Readers are certainly familiar with instances of physical equilibria -- the balance that inner-ear fluids make possible and the tendency toward life-preserving metabolic changes when one climbs a mountain, for example -- but they may not have considered equilibrium as important in a non-physical context -- in the context of people's perceptions and ideas and general head-picture of the world.

By equilibium is meant the tendency to preserve one's self and at the same time to extend one's self. What we all do is to seek equilibrium and to invent disequilibrium, especially in the realm of experience and ideas. (Think, for example, of the career of a chess player from first fumbling play to expert. Think of a person learning to ride a bicycle. Think of YOUR career or hobby.)

A general term for that which causes disequilibrium is dissonance. Dissonance is the mismatch between where we are and where we want/need to be (or where a situation calls for us to be). The best observation of dissonance -- though examples are everywhere -- came some years ago when I watched a bunch of teenagers learn to toboggan. Six of them there were, and at first they tenderly, gingerly, edged one person over the lip of a hill. Within a half hour, they were laughing and hollering and flying down the hill six on the sled. And by evening's end they were heading downhill, six of them, standing backwards on the toboggan, daring a nearby tree to come close to them.

Some aspects of dissonance -- all of them at work in our every waking hour -- are risk, competition, challenge, surprise, novelty, mystery, incongruity, and uncertainty. (You might want to add to the list yourself.) These things are the spice of life.

Back to where we started. A two-year old and a teenager are patently very different from one another. But in a deeper sense -- in the sense of underlying tendencies -- they are very much the same. The two-year-old is at an early stage of establishing equilibrium with respect to his/her surroundings. The two-year-old, intrigued by everything, into everything, is a whirlwind of dissonance. The teenager, though more mature in logic and language than the two-year-old, embraces dissonance just as fully. The computer freak, in particular, seeks novelty, challenge, surprise, and competition (often self-competition) as the result of the built in (hard wired?) tendency we have both to preserve ourselves and to extend ourselves. In a deep sense, the teenage computer freak is the two-year old writ large (as we all are, in fact). (Note 10)

There are several major points to be learned from these teenage computer jocks, I think. One is that children (and people in general) are often immensely more able than we think. Second, they are usually self-taught. Third, they are often self-sustaining in their growth, a point frequently overlooked by parents and teachers who see themselves as the only source of knowledge.

But perhaps the most important lesson to be learned is the power of dissonance in the life and growth of children, an issue with which American education is wholly unacquainted. As the educational software industry moves out of its baby shoes, we educators have the opportunity to capitalize on dissonance --

quest, challenge, surprise, uncertainty, self-competition, risk, incongruity, complexity, curiosity, the tendency to move past one's present state to be the best one can be-- as elements intrinsic to the learning situation.

This is precisely the stuff that has been overlooked in the past sixty years of behaviorist, minimalist, and efficiency-dominated American education. (Note 11) We should learn from the computer freaks and the two-year-olds. The tendency to engage and resolve mismatch -- and to create mismatch just for the joy of resolving it -- is built into us all. As educators, we might be wise to see children as wearing signboards saying "under construction" or, better, "under construction, self-employed."

NOTES

1. Douglas R. Hofstadter, Godel, Escher, Bach: An Eternal Golden Braid, New York, Vintage Books, 1979, p. 26.

2. T.C. O'Brien and S.A. Casey have just completed a research in which children in grades 4, 5, and 6 were asked to complete five multiplication computations. The success rate was 82, 75, and 97 per cent, respectively. Then children were asked to make up a story problem for the multiplication "6 X 3 = 18." Seventy five per cent of fourth graders were unable to do so, even though repeated addition was regarded as correct. At fifth grade, the figure was 85 per cent and at sixth grade the figure was 30 per

cent. Of all responses, half or more were straight addition: "Six girls came to a party and 3 boys came to a party. How many people in all? 6 X 3 = 18."

Astonished, we ran the same research at a different school with virtually the same results. See T.C. O'Brien and S.A. Casey, "Children Learning Multiplication", School Science and Mathematics, in press.

3. The situation was such that the Teachers' Center Project responded by producing (available at the cost of printing) "Away from Basal Texts," a sampling of published thought-provoking activities for children, many of them from little-known publishers.

4. This issue is developed more fully elsewhere. See T.C. O'Brien, "Software Encounters of the Second-and-a-Half Kind"

5. "Dice" is avilable as a public domain program for Apple II computers from Willy and Jacqueline Vanhamme, Institut de Mathematique, Chemin du Cyclotron 2, B-1348, Louvain-La-Neuve, Belgium.

6. "The Factory" is available for Atari 400 and 800 computers from Sunburst Communications, Pleasantville, NY, and from Atari, Inc., Sunnyvale, CA.

7. "Gertrude's Secrets" is available for Apple II computers from The Learning Company, Portola Valley, Ca.

8. "Taxman" is available for Apple II and Atari 400 and 800 computers as part of MECC Elementary Volume I, Minnesota Educational Computing Consortium. Available also from Sunburst Communications, Pleasantville, NY.

9. "Functions" is available as a public domain program for the Apple II from Willy and Jacqueline Vanhamme. See Note 5.

10. This, of course, is a position supported by fifty years of Piagetian constructivist research. For a summary of the work, see H. Ginsburg and S. Opper, "Piaget's Theory of Intellectual Development" (Second edition), Englewood Cliffs, NJ,: Prentice-Hall, Inc., 1979. See also M. Boden, "Jean Piaget," New York, NY: Penguin Books, 1980.

11. For a history of the mechanistic underpinnings of American schooling, see R. E. Callahan, "Education and the Cult of Efficiency," Chicago, IL: University of Chicago Press, 1962.

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AN APPLE FOR THE TEACHER

Evlyn D. McQuinn

Mrs. M.: Sure glad you're home, son. It's been a long time between visits.

Alan: It's great to spend Christmas with you; but soon I'll be going back to work.

Mrs. M.: If you want to see your friend Rick while you're here, he is working at the new computer store in the shopping center.

Alan: Is he selling Apples?

Mrs. M.: Selling apples? I just told you, he works at the computer store.

This conversation occured several months ago, and since then I've learned that there are apples, and there are Apples. I remember how "stupid" I felt when I made this communication faux pas. I just knew I was the only person in America who had never heard of Apple computers. I didn't know anything about computers except that computers were something used in businesses and something students learned about in data processing classes in colleges. As an elementary teacher, surely I would never be expected to be a computer expert, too.

And then . . .

Mr. P.: Mrs. M., we believe we will have enough in the budget to purchase a computer for your classroom.

Mrs. M.: You mean, I will be teaching with a computer next year?

Mr. P.: It looks like it.

Mrs. M.: (aloud) Super! (to self) What in the world am I going to do with a computer?

Mr. P. was pushing me into a new realm. When one gets pushed off the pier, one either drowns or learns to swim...quickly. I chose to rescue myself by learning to swim. Or, in this case, to learn about computers.

At Instutute time I selected and attended the sessions that promised some insight into the world of computers. I signed up for every workshop I heard about that even hinted at information on computers. I discovered magazines that helped me learn that software is not something you wear. I've found friends who are willing to help me, and who were patient (and didn't even laugh) when I referred to a "floppy disk" as a "flimsy disk." One person even let me borrow her computer for a weekend.

These experiences helped me with the mechanics of operating a computer, and helped me become familiar with computer language. Bits and bytes, RAM's and ROM's became a part of my vocabulary.

But,...What am I really going to do with that computer in September? How am I going to use it to help kids learn? I can't teach programming, as I don't yet know how to write programs.

I've learned that hundreds (perhaps thousands) of programs have already been written. I don't need to write my own programs, but I do need to be selective in choosing which programs to use.

The most valuable thing I have done thus far is to spend a lot of time looking at software to see what quality educational programs are available. The opportunity to look at many pieces of software was offered to me in Tom O'Brien's class, "Elementary Math and Computers." Reading in-depth evaluations, such as those given by David H. Ahl in "Learning Can Be Fun", an article in Creative Computing, April 1983, (pp 98-143) has been helpful. Good material is available, but one must be willing to spend some time to find it.

I know now that the programs I use will have to have more than eye-hand coordination as an objective. I want the programs to be more than motivating. They should do the things that computers do best. They should open up new avenues of learning. I don't want programs that are nothing more than computer flash cards, or workbook pages adapted to a computer. I want programs that make kids think and help kids learn to think.

School begins again in a few weeks, and I don't have a formal computer curriculum ready. I know that there are some appropriate programs available and I must be willing to search for them. I do have some ideas of thinga I want to try with the kids. I'm aware of a few programs that I think are good. However, programs that I think will be great for my students, may not be suitable for the students in other classes. I plan to enroll in additional courses. I want to learn to program so that the option of teaching programming to kids is opened. I want to continue to find ways to use the computer with my students.

While I still know more about food processors than word processors, I feel that I'm becoming computer literate. If you are just beginning to explore the world of the microcomputer, take heart. There are many of use exploring with you. Let's help each other through the maze.

AN INTERVIEW WITH MARGE KOSEL

Marge Kosel is Computer Director for Sunburst Communications, Pleasantville, New York. She was formerly product director for the Minnesota Educational Computing Consortium. Fred Criminger is General Manager of WSIE, SIUE's National Public Radio station. The interview that follows was broadcast on WSIE's Education Today program in June 1983.

Fred Criminger: Are you primarily an educator, Marge, or primarily a computer expert, or both?

Marge Kosel: I would term myself an educator.

Criminger: Your background is education. Elementary or otherwise?

Kosel: I originally started out as a high school math teacher in a school district in Minnesota. Then I moved on to working with an organization called the Minnesota Educational Computing Consortium, where I did teacher training. I worked with about 50 or 60 school districts, teaching teachers how to use computers. At that time we were using what they called time share computers on a very large computer system. The schools had little devices that hooked up by telephone to a computer many miles away.

Then I moved on to the whole area of microcomputers. I was in charge of software development; i.e. we developed programs for schools to use on microcomputers. Then about a year ago, I came out to New York to be in charge of development of school software materials for a publishing company called Sunburst Communications.

Criminger: Is the software in general pretty sound or is it a mixed bag?

Kosel: Right now the whole area of computers is exploding. When the microcomputers first started to come out a lot of software was not very high quality. I think that's changing. There used to be a lot of people sort of working in their basements at home developing software. Much of it was pretty primitive. The software now is getting a lot better.

Criminger: Are the schools implementing this type of instruction fairly rapidly?

Kosel: That's always a major problem, because any time you make a change it takes training. Most of the teachers in the schools haven't been trained as to what computers are. Too often when a school district gets into working with computers there is a tendency just to buy a computer system -- what we call the hardware -- and not to budget for training. Then they have problems finding out ways to use the computer in the classroom. I think that is improving. There needs to be three phases to a school district's computer program. There is the actual hardware that they will be using. There's the actual software (the programs that will be running). And then there's the teacher training that must go on.

Crimingers: I'm wondering how many schools that train teachers are really going into computers in their training programs?

Kosel: A lot more school districts now. Do you mean teacher education institutions?

Crimingers: Yes.

Kosel: The colleges are also switching, but that takes time because they need staff to teach it. In Minnesota I worked with colleges and they had a problem getting staff.

Crimingers: Do you see kind of a revolution? Or an evolution? Which? Or maybe you'd use a different term. Do you see a real major change coming into our schools?

Kosel: Oh, it probably will. I am kind of conservative on that one. I still feel fairly strongly that the teacher acts on the whole educational process.

In some ways the computer will change what we are teaching and how things are taught. There are times when having kids work with computers will be a better way of learning. I see education changing because there has to be a lot more emphasis on thinking and problem solving than on drill and practice. Kids are going to go out into an ever changing world and much of what we learn in school is not going to apply twenty years from now. So schools are going to have to teach more of the thinking process so that students can be able to adopt or adapt when the world changes around them. The computer can really help out with that, because there are things that you can do on the computer system to help teach thinking and problem solving that have been hard to approach in a classroom situation.

Crimminger: Do you see any sort of reinforcement from various out-of-school sources? For example, many kids have gone hog wild over electronic games and so computers have found their ways into a lot of homes. And as you know, computer recreational centers have opened all around the country. Does that tie in any way? Do the kids become used to working with computers and carry that over into the classroom?

Kosel: I think that kids in general adapt to computer systems a lot easier than adults do. Every time I go out and do a presentation with teachers, I ask for volunteers from the audience. They will say, "Oh, I don't want to come up and touch the keyboard." "I am afraid of the computer." When I go out and present to a group of elementary students the computer system, there are twenty volunteers who want to come up and touch and work with the computer. So that I think that the students will adapt a lot easier to computer systems because they play video games and because they do a lot of other activities that relate to the computer, probably more than adults do.

Crimminger: Following this a bit further. Say a kid has what amounts to a computer at home and he is used to working with computers in recreational centers. Now computers begin to come into the school. What about education in the home? Do you foresee the day when schools, at least in part, move into the home via computers?

Kosel: I think that we are going to get to that day. The problem we have right now is that not all kids have computers at home. Then there's the a problem that people will have different kinds of hardware at home. I might have an Apple and you might have an Atari and someone else might have a Commodore 64, these being different brand names of hardware. Things aren't compatible from one machine to another. But yes, I think that we will get to the day that kids will be learning a lot of things at home and a lot of education will be going on at home that may have traditionally been done in the schools.

Some of the futurists predict that education will be going on almost exclusively in the homes with students sitting in front of some computer system, interacting with it and learning what they normally learned in schools. I guess I don't quite go that far. I think that we are still going to have schools and teachers will be teaching certain things in the schools and that will be extended at the home level.

Criminger: You mentioned the fact that right now you have a terrible problem with one system not fitting another. No standardization. Are some people working on that?

Kosel: I don't think that there is anything being worked on right now from the software point of view. We have to remake the program for every machine. Right now it's like when you go out and buy a part for your GM car and that part will probably not fit a Ford car. If you buy a burner for a Westinghouse stove, it won't fit another brand. I don't know if we will ever get to the point that there will be compatibility in the machines. That's what sells the machines--the special features that one has that the other machine doesn't have.

Criminger: A lot of people are thinking about buying computers for the home. They are trying to think about everybody in the family including the kids. I think that they would find it very confusing. You know, advertising says that our computer is the best, ours will do more than the other guy's. The poor consumer is kind of perplexed. You have been working in this area. What would you look for if you were going to buy a computer for use in your home?

Kosel: I would sit down and ask, "What do I want to do with that computer in my home?" "Do I want it to help me maintain my checkbook?" "Do I want to be able to write letters?" "Do I want it to help me with the business that I am running at home?" "Do I want it to help me educate my children?" ("What ages are they, and what type of education do I want them to get?") Then I'd pick the top four items on my list. I would go down to the computer store, and I would say, "Show me something that can do these four things." Then I'd let them convince me that that was the machine to get.

Criminger: Okay. Now what if you were a school administrator who was thinking about buying some computers for use at school. What would you look for?

Kosel: I would approach it from the same point of view. What do I want the machine to do? Do I want to use it in my office to maintain school records or do I want to use it for the kids in the classroom? If I want to use it in my office to keep school records, I'd need a printer to print out those records. For office work, I would want the computer to be able to work with a lot of numbers and words easily.

If I want the computer for the classroom, I would probably want a lot of graphics and sound. (I probably don't need those features to maintain my school records.) And I'd want to know that there's a lot of good software for the computer. Here's where the question "What type of education do I want?" comes up.

Crimminger: You have been working to marry education and computers. You probably have some interesting and exciting developments. Can you talk about some of those?

Kosel: I love the computer field because it is changing every day. The change from when I first started working with schools to the situation now with microcomputers was exciting. All of a sudden micros started to be advertised on TV and you would walk into a school carrying a computer and a group of kids would say, "I saw that," or "I have one those at home." Society is accepting the machine and even little kids are becoming acquainted with the computers. That's exciting.

The other thing that is really exciting about the field for me is that there is no one way, no one set form, that this will succeed or that won't succeed. There's a whole bunch of things that can be tried. Sometimes I go into schools and talk to the teaching staff and they expect me to tell them exactly what to do. There really is no one thing to do. Many innovative teachers come up with different ways of using the computer that I never have thought about before. Because it is so new, we don't have everything down pat. In the whole computer area, we're still learning. We don't know the effects of computers on society and we don't know where we are going to be twenty years from now. It is interesting to watch that evolution take place.

Crimінger: You said that you didn't go quite so far in your own projections as some people who are predicting that most students will not be even going to school but will be sitting in front of their computer. And I suppose some people won't be going to work. They'll just sit down in front of their computer. But there are social implications in those projections, are there not? There are families where both parents work and if they had to go off to work, they wouldn't want to leave the child at home in front of a computer. That's just one example.

Kosel: I agree. That's why I don't really think that it is going to happen, but not for that reason as much. I think that it is the way we learn that will make the extreme futurists wrong. Just as it would be very difficult to read for twelve hours a day, five days a week, I think it would be very difficult to sit in front of a computer terminal that long. Humans like variety. Imagine a teacher standing up all day and lecturing. You'd get bored with it. One of the big things in learning is variety. So I think that some learning will come from the computer system, some by someone telling you about it, some by reading it in a book. That's what learning is all about. I don't see just one method of learning and so I believe that there will still be schools and that the computer will have an influence in those schools, just as other kinds of teaching tools that a teacher has. It is just one other tool. The computer becomes a very powerful tool and it can do things that we've never been able to do before, but I don't think that it is the one answer and that it is going to take over all of our education.

Crisinger: This is going back into the dim, dark annals of time. Way back when I was doing graduate work there was a great deal of talk about programmed learning. Is that still involved with the computer or is that kind of passe?

Kosel: I don't like programmed learning. Although every kind of learning has a place and there are some things that are good to learn that way, I think that an over-emphasis on programmed learning, just like an over-emphasis on any kind of an approach, is not good. The computer can take the kids step by step through something but one of the real powers of the computer system is to be able to do things randomly and to provide variety and to bring a sort of excitement with learning that doesn't happen in the programmed learning situation. In programmed instruction you ask a question, give an answer, give a little bit more information, ask a question, give an answer. There are more innovative and fruitful ways to teach things and make them a lot more fun to learn.

Crisinger: Can you give some reasons why a teacher would want students to be exposed to a computer?

Kosel: Because that's the world that we live in. We live in a world where the kids are going to have to deal with computers. Computer literacy -- to know what the machine is, to be able to talk about the machine, to know what a disk drive is and what a disk is, to know how you can store information in the computer and how you can change information in the computer -- is very important for those students. The other reason that I as a teacher would want to use a computer is that it can help me teach things in a way that I couldn't teach them before. So I would use it because the kids are going to live in a world that is very computerized and because I can approach learning and teaching in a very different way.

Criminger: We included automation, which is a simplified form of computerization, when we built the radio station here. Our thinking was similar to yours. We thought that our students should be familiar with that approach as well as the more traditional approaches. I guess this sounds a little science fictionous or a little futuristic, but is there a danger of a student getting so enamoured with computers that he could use them as a crutch and if the computer broke down he wouldn't know what to do next?

Kosel: We have programmers who work with the computers and sort of love them in a way. They work with them eight hours a day for programming, but I don't think that they'd ever feel that they were a crutch. I think that they see them more as an opportunity. The computer extends the mind, it doesn't deaden the mind.

Criminger: What if your computer blew a fuse?

Kosel: Maybe there are some things that if my computer system broke down I would put off doing. Just like if every morning I have toast and all of sudden my toaster breaks down, it sort of upsets me. I would have to find another way to make toast or wait until the toaster got fixed. I think that the same thing could happen with a computer system. You'd be frustrated because it broke down and you have to find another way of doing your work or you have to put it off.

Criminger: Let me give you an example with the calculator and see what you think. If I were a math teacher and I were convinced through various traditional methods that my students had mastered various types of mathematics, in other words they could do it with a pen and pencil, I think that at that point I wouldn't have any particular qualms just to speed things up and make life easier if sometimes they used calculators in their calculations. But I can see a danger in using calculators or computers before you have mastered the thinking so that you fully understand what it is that you are doing.

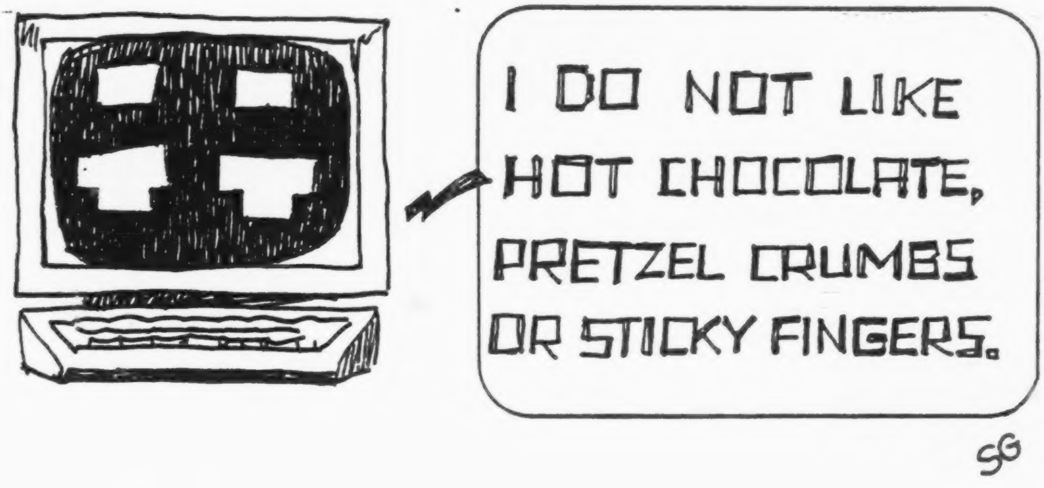
Kosel: I agree. You can't use a calculator effectively without understanding what you are doing. To use a calculator you have to be able to push the buttons intelligently and you have to be able to estimate the answer. You have to have some concept of what the problem is and what the solution will be. What the calculator does is give you the exact number, but you still have to have an idea of whether it's going to be fifteen hundred or fifteen. So I think that schools have to teach the kids the basic foundations. It's a basic foundation in thinking to know how to approach a problem and how to know if you have the right solution.

Crimінger: What are some of the areas in which computers right now do best in teaching students?

Kosel: I have a biased view of where computers fit into education and that's that they really act as tools. In the area of word processing, I've seen some really good things happening in elementary schools. I guess I never realized it before because I had never been an elementary school teacher, but paper and pencil things are competely dominant. One time I went into a second grade classroom to work with some kids on a computer system. We were doing basic math drill kinds of things like 5 + 7, that we had put in a game format. I asked one of the girls what she liked about the computer system, and she said "I don't have to write out the answer." She showed me her hand and showed me a bump on her finger that was from holding a pencil. Writing for little children is a very difficult task. It takes a lot of coordination and it often gets in the way of more important things like thinking. Often a student won't go back and rewrite something because he or she has to write the whole page over again. To write a whole page over again often takes fifteen minutes to a half an hour to forty-five minutes. What a waste of time. And what devastating effects on children!

But the most important aspect of computers in the classroom is the opportunity to get children thinking and problem solving, to get them to come up with original solutions to problems of mathematical or scientific or literary importance. That's the most important thing. But that would take us another hour of conversation to discuss and we haven't got time here.

Criminger: Would you believe that our time is up. We've been talking to Marge Kosel about Computers and Education and what the future holds.


I DO NOT LIKE HOT CHOCOLATE, PRETZEL CRUMBS OR STICKY FINGERS.
SG

COMPUTERS IN THE CLASSROOM

General Software Evaluation

Helen L. Miller

"In the 1980's both adults and children will be able to have as a personal possession a computer about the size of a large notebook with the power to handle virtually all their information-related needs." This is Alan C. Kay's prediction for the immediate future which has vast implications for education, in general, and for teachers, in particular.

Computer software can be a valuable tool for teachers at all levels. It can visually enable a student to understand concepts that were previously merely vague abstractions. It can simulate conditions as abstract as earthquakes and as laborious as tossing dice a thousand times.

Software is a powerful tool for teachers to use in the classroom. It can help students learn new skills, enable them to find new ways to solve problems, challenge their thinking, help them identify relationships, provide a means for predicting and for testing their ideas, and encourage them to use their mental powers.

Although children today accept computers as part of their everyday environment, many adults seem to be intimidated by them. Single purpose computers, such as those used in children's toys, washing machines, microwave ovens, and automobiles are part of everyday life. It would be hard to imagine what we would do without pocket calculators, another kind of microprocessor.

How can a teacher learn to use a computer? The only requirement is the opportunity for "hands-on" experience. Good software and documentation can enable most teachers to use the computer successfully.

Programming language such as PILOT is designed to be used by teachers in order to create instructional material. LOGO is a programming language designed for children to use to learn how to create their own programs. Many of the computer companies have software available that will enable a teacher to utilize these programming languages in the classroom.

In the pre-computer era teachers used materials developed by others, even though there were times that they felt the material was inadequate. The only alternative was to create worksheets in order to facilitate learning for students.

The computer now can be a powerful tool for the teacher. With good software, programs can be created that will fill an immediate need or relate to a specific problem. The potential of software far exceeds that of the worksheet material.

The computer is a mind appliance. Through the use of good software teachers can help students expand their thinking and explore their ideas far beyond what was possible in the pencil and paper age.

The teacher does not have to learn free form communication with the computer in order to utilize the computer in the classroom. A teacher DOES have to use his/her expertise about children and about how they learn in order to select those programs which will facilitate learning in the classroom. Teachers must be cognizant of the types and of the quality of various programs if computer software is to be a viable tool in their classroom.

It is imperative for every teacher to have clearly in mind the purpose of the software--tutorial, creative thinking, reinforcing previously acquired skills. Clever programming and colorful graphics will not achieve the results that a program which has developmentally appropriate language and concepts and accurate information will achieve. There are many poorly constructed programs that have been very ingeniously and colorfully programmed.

The following pages contain guidelines to enable teachers to evaluate software which is available for use in the classroom. The importance of the teacher's knowledge about children and about the way they learn is an integral component in determining the value of computer software. It is the teacher who will inevitably make the computer a viable tool in the classroom.

Guidelines For Computer Software

Student value:

1. Is the program developmentally appropriate?

    Does the student have the skills needed to understand the concepts presented?

    Does the student understand the terms and the language used in the program?

2. Does the program reinforce learned skills?
3. Does the program encourage responses (choices), rather than threaten if a wrong answer is given?

    It is discouraging to be told that your score or response was very poor.

Has the programmer considered all possible correct alternative answers?

4. Is the problem clearly stated?
5. Does the program relate to the student's past experiences and does it prepare him for worthwhile new experiences?

A program dealing with the ocean may not be meaningful to a child who lives in the midwest and who has never been away from his immediate area.

Are the terms and the language used in the program those with which the student is familiar?

6. Does the program challenge a student's thinking?
7. Does the program have directions which will enable the student to easily relate to the keyboard?

For young children this is very essential!

Do the directions in the program facilitate the use of the program, or do they distract and confuse?

8. Is the program visually interesting?

Are the graphics helpful or are they difficult to understand or to relate to the real object?

Do the graphics enhance the program or do they detract from the purpose of the program?

9. Is the issue worthwhile for the children to engage?

Teacher value:

1. Are the objectives of the program clearly stated?

Is there material for the teacher to use that clearly states the objectives?

Does the material indicate the manner and the language in which the program will be developed?

Are the objectives sensible, however clearly stated?

2. Can the teacher adapt the program to coincide with current classroom needs?
3. Is there supplementary material readily available?
4. Does the program require teacher interaction with the student as he uses the program in order to be effective?

   Can the student follow the directions in the program without teacher assistance?

   Can the student understand (read) the directions by himself?
5. Does the program encourage peer interaction?

   Can more than one student use the program cooperatively?

   Will peer interaction facilitate learning when a particular program is being used?
6. Can the program be used in a classroom when there is a limited amount of time available?
7. How much teacher preparation time and effort is required to utilize the program?

Educational value:

1. Are the language and the ideas in the program developmentally appropriate?
2. Are the language and the ideas in the program educationally sound?
3. Are the questions clearly stated?
4. Is the information accurate?
5. Are the directions clear and concise?
6. Does the program attempt to motivate students?
7. Does the program consider other areas of learning?

For young children it is important that the reading skills involved (eye movements, etc.) do not conflict with the reading skills used in the classroom.

Are math problems written in a way that is familiar to the students?

8. Does the program encourage students to employ previously learned concepts and skills?
9. Does the program allow the student to make a mistake without making him feel as though he has failed?
10. Is the program developed in a manageable sequence?
11. Is the program developed in hierarchically appropriate levels of difficulty? Does it allow children to "stretch" their thinking?
12. Does the program enable the student to get feedback in order to re-examine his/her thinking?

Technical value:

1. Is the script clear and concise?
2. Are the pictures accurate enough for the students to identify them in the same way as the program labels them?
3. Can a student "get out" of a program that is boring and proceed to a more challenging one?
4. Does the program enable the student to use the keyboard efficiently?
5. Does the use of color and/or sound facilitate learning for the student as he uses the program or do the special effects intrude on the educational effects?

Computer terms:

1. Computer -- a mind appliance that can solve problems, print

words and graphics, store information, retrieve information, manage information, play games, etc.

2. Diskette -- a floppy disk which is a pliable, plastic-coated magnetic storage medium about the size of a 45 RPM record.
3. Disk drive -- current storage and retrival medium; an extension of the computer's personality.
4. Software program -- series of interrrelated instructions for the computer intended to generate something worthwhile.
5. Hardware -- the computer and computer related equipment.
6. Keyboard -- much like a typewriter keyboard with a few special keys.
7. Chip -- a silicon based circuit used to hold active programs and/or information.
8. Monitor or TV -- used to display information established via software.

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An Interview With Liza Loop

Liza Loop is director of the Loop Center, Palo Alto, California. She visited Southern Illinois University at Edwardsville for work with teachers in April, 1983. Mary Steffen teaches at the Walnut Grove School, Florissant, Missouri.

Mary Steffen: Tell us how you got started with computers?

Liza Loop: I'm completely self-taught. I don't have any formal training in computing and I'm my own best guinea pig. That is, I try to learn the hard way, as if I were a beginner.

In 1972, I took a course in Nursery School Education. One of the instructors, Dean Brown, had children (2nd, 3rd and 4th graders) working on teletype terminals connected to the Lawrence Hall of Science at the University of California/Berkeley. Well, if those kids could do it and have all that fun, I could do it.

That was my introduction and it was marvelous. It took about five minutes of listening to Brown to convince me. I said, "That's my career. I'm going to go off and learn how people adapt to this new technology." But where should I go? There weren't any microcomputers. There weren't even people you could talk to to ask about how the equipment works. (One of the things I have learned is that finding people whom you can ask is an awful lot easier than going out and struggling through the manuals by yourself.) I tried the local college library and got a filmstrip which supposedly taught you to program in Basic. And I got an account with the college computer. Then I could fiddle with their state-of-the-art, very vanilla, time- sharing computer. At that time most students keypunched their programs in Fortran or Cobol and submitted the deck of cards to the Data Processing Department. Twenty-four hours later you would get some sort of printout. Usually your first three or four printouts told you that your cards were out of order but they didn't let you know whether the statements on the cards were wrong or right. It would take weeks to get the program debugged.

Most people who worked with computers then were learning to program. They were not using computers as a tool for everyday work. I decided that computers could and should be a tool of Ordinary People. I didn't know for sure whether Ordinary People could get access to this equipment, but I thought this might be a fantastic area to get into. It seemed to me that there was a great void between Ordinary People and the priesthood of people who were in the know, who spoke the right jargon. I knew that there needed to be a mediator betweem the two.

So that's what I have been. I have tried to stay a beginner. I don't study hard and learn a great deal about computers because I would lose my innocence that way. I might lose the ability to speak English. Since 1972, I've been a mediator in all different ways. Talking to teachers about computers is just one aspect of my life.

Steffen: Let's move onto education more specifically. What's going on now with computers? Where are we? Where are we going?

Loop: Everybody is in a panic to get on the bandwagon, to learn something about how to operate a computer. There has been a tremendous drop in price. Everything that the advertisements tell us is true: the machines are cheaper and friendlier. Western society has realized that these machines are an important part of our future.

I suspect the same thing happened when books first became mass consumer items or when electricity became available to the average household. There was a tremendous need to find out how to operate the new technology.

In schools, I find the teachers struggling to get their heads above water. Usually, it's a struggle just to approach the technology. There's not too much time or energy for deep thought about what we are doing and why. One hears lots of lip service given to the idea that we have to have computers to teach problem solving, for example. I think that nothing could be farther from the truth. Computers don't solve problems and never will. Computers repeat problems solutions. If you can't solve the problem without a computer, you can't solve the problem with a computer.

Steffen: What can computers do?

Loop: The computer is a really fast idiot. Th computer can follow a list of instructions correctly and rapidly. A computer will follow those instructions exactly, no matter whether they are right, wrong or completely stupid.

A computer can do calculations. It can move messages from one place to another. (For example, from the keyboard to your screen, or down a phone wire to someone else's screen. It can move a message from its memory to a switch that turns a lamp on and off.) Moreover, with the right program in its memory, it can deliver messages in a delayed fashion. Thus it can stand in to solve problems for you. That is, if you program it with a problem solution and go away, the computer can repeat the solution when you are not there. In short, a computer can do very simple and very complex tasks for you, but you have to tell it what to do.

Steffen: How are computers being used in the classroom now?

Loop: Some people are using them as laboratories for learning about computers.

Steffen: Programming. Is that what you mean?

Loop: Programming is one application. But, more generally, one can learn the limitations, opportunities and restraints of the machine. You can get the computer to do calculations faster than you can, but in many cases you may be able to do the math "by hand" faster than you can program the solutions for the computer. You learn that it's wisest to use a program for problems that you are going to have to solve over and over again. Unless there is a huge amount of calculation to be done, you usually don't program a computer for a one-shot application. Knowing this is one cornerstone of computer literacy. I believe it is just as important to know when to turn the computer off as how to turn it on.

Now back to programming for the moment. One piece of research I am very interested in doing concerns programming. There are kids who learn to program relatively easily. They catch on quickly. But there are more kids who don't learn to program easily. They never become good or fast at it. My hypothesis is that most of the students who master programming bring the capacity to program into the classroom and the classroom becomes a laboratory to hone that skill. I think that there is a set of computer readiness skills that the ones who succeed bring with them. They don't learn those skills within the classroom. We really need to look at the supporting skills for conceptual problem solving (programming is one form of conceptual problem solving) and we need to teach the pre-skills to the kids who don't already have them. I think that you don't teach the pre-skills via computer; you teach the pre-skills with live teachers who are themselves good problem solvers.

Steffen: Are you referring to little kids or older kids?

Loop: Well, if you don't have the pre-skills, it doesn't matter how old you are. Many people tend to say that programming teaches logical thinking. Some people whose minds work in a step-wise process (like computers use) claim that any other kind of thinking isn't logical. I think that that is a narrow-minded attitude. Creative divergent thinking is just as logical as step-wise convergent thinking. It's just a different kind of logic. It would be a tremendous shame if we view convergent logic as the only kind of worthwhile thinking. As we have more and more computers functioning, we're going to find that people whose thinking is computer-like are obsolete because computers can do it better and faster. I hope we don't develop a shortage of creative human beings in the meantime.

Steffen: Say more about computers in the classroom?

Loop: Right now, the stand-alone micro-computer is a wonderful delivery tool for drill and practice. It can provide automated ditto sheets and animated, illustrated ditto sheets. It can have the magnetism of Saturday morning cartoons and video games with "redeeming educational value". But I think you are using the word "classroom" to mean "place where a person receives teaching". As we become more sophisticated in our use of both computers and communications technology we will view them as a delivery tool for courseware where a student is in charge of his or her own learning. Suppose you want to take a course in Orthodox Russian History, for example. It doesn't matter if you are 7 or 17 or 70, you can dial up your local bank of courseware and get the tutorial material, the assignments, and the testing for the whole course, the recordkeeping too. Your record is then entered into your transcript by the computer. We are just beginning to use this kind of system in colleges. I think we will move it down into the lower grades. There is no reason you can't have developmental skills for two- or three- year-olds available at home or daycare centers through the computer.

The teaching function and course delivery function of computers--combined with recordkeeping--are aspects we are just beginning to experiment with in a very elementary fashion.

Steffen: What happens when a school buys computers and then begins to use them? What's the usual sequence of events? And how would you change that?

Loop: Well, on hardware selection, what should happen, usually happens backwards. What should happen is this: decide what you want to teach, look at your resources, decide what role you want for the computer, find out what software is available to accomplish your goal; and then go out and find the machine that supports that software.

Unfortunately, what usually happens is teachers get hit with: "Today we have the money. It's going to be available until somebody else nabs it. So we have to spend it by tomorrow afternoon. You, Ms. Jones, have worked with a computer, but nobody else in the department has. So please, decide what's the right hardware and buy it." Sometimes "Ms. Jones" is a committee, in which case the decision takes longer. A computer is purchased but few funds are provided for software and none for staff training. The machine spends a year or more underutilized or used not at all. (Often it winds up in a closet in the math department. The only people with keys to the closet are four advanced students and one gung-ho computer teacher.) In one school in California, the computer has sat unused for two years. Everybody has complete access to it but no one knows what to do with it. So, it sits there, one of the loneliest pieces of equipment in the school.

The climate is now changing so that people are beginning to acquire a whole lot of hardware. When they can't figure out how to use it, they often jump to the conclusion that they've bought the wrong hardware. I think that it's important for teachers and administrators to be painfully honest about what they really need to accomplish. So if improving SAT scores really is a hidden agenda, for example, you need to take the covers off that and admit it. Use the machine to accomplish goals. If you find yourself with hardware and SAT's are your goal, then look for software that will bring out the kind of problem solving techniques that are needed on the SAT exams. You seek out what's available, read reviews and make judgments. This is where the teacher is so important. The teacher decides what the goals are. Then the teacher evaluates the tools he or she is going to use to accomplish those goals. And the teacher is on the line to decide whether it worked or not. You can't say, "I bought a fantastic computer system, hardware and software, and I left it in the closet. Therefore, it didn't work." in such a situation you have to admit, "I didn't use it."

We haven't mentioned ways that computers are being used in the classroom to help teachers to get their paperwork and recordkeeping done. Computers were originally designed and developed as calculators, and from calculators they went to data processing machines. There is a lot of software for classroom management, grade reporting, library cataloging, circulation, and keeping track of student records. All this is a very valid use of computers. Here computers are teacher tools, an aspect of computers as people tools.

But the teacher is not the only person in the classroom who needs tools. I want to see students consider a computer as a tool that goes under their arm like a pencil or a piece of paper. (I don't say like a textbook, because at this point we still consider textbooks as belonging to the school and not the student. Textbooks are really teacher tools to expand and extend the teacher's delivery; they are rarely student tools at the elementary level. To me this is the most exciting thing! The microcomputer becomes the student's own and the student uses it for word processing or for calculating, for help in solving problems, or anything he or she can think of.

Steffen: One thing I've been interested in is computers with special kids--the very bright and the learning disabled. What potential do you see for that special kind of child in the classroom, hardware and software as well?

Loop: You said, "in a classroom," and the image that that brings to my head is 20 or 35 or 40 people collected in a room for extended periods of time. My picture of special kids is that when you put them in that kind of environment, the repertoire of the behaviors that they are able to exhibit is limited or distorted. If they have emotional problems, they often can't function in that large a group. If they have figure ground screening problems they often can't concentrate in a classroom group. I myself find large groups very limiting.

In a sense the computer serves those kids by providing a focal point and by allowing them to mentally escape from the classroom environment. For example, if there's a child who needs lots of extra drill and practice, you can put a computer in the back of the room, and let that child do drill and practice. The child often will stay on task for the first time ever. Working with the computer, he or she has the privacy of getting extra practice, without everybody else knowing it and without holding up the whole class. They don't get teased about the fact that they need 100 trials where some other kid might need 5 trials. I happen to be that kind of learner, so for me the fact that I can go over and over and over the same material is a great boost and the rest of the world doesn't have to know about it.

Or suppose a kid is particularly sensitive to emotional face-to-face distractors. My son, for example, is motivated most by pleasing somebody. He could care less about the educational content of what goes on at school, but he really loves to have an adult sit down and pay attention to him. He has discovered with human teachers that the best way to get attention is to give the answer wrong and refuse to stay on task. For him, human help decreases his intellectual performance drastically. Now if I can get him interested in a video game that has some educational content, he'll stay on task and get the practice he needs. If I hire a tutor, he won't. Privacy and patience pay off with these kids and good computer software will offer both. You can use computer systems in all sorts of situations and the limitations are only the imagination and know-how of the teacher who sets up the computer station in the class.

Steffen: What are the kinds of things that computers can do to change classrooms?

Loop: I started out with the hypothesis that classrooms themselves often create problems. With a large number of people gathered in one room, people have to limit their behaviors (in terms of their talking and physical movement) and their personal habits. Lots of personal habits, lots of different behaviors have to be controlled in order for them to be in that social group called "the classroom". If we break away from that structure, we can accommodate a whole different variety of learning needs. Any of the new little microcomputers can be equipped to deliver education and information to any place where there is a telephone. So the computer can open tremendous possibilities for new educational situations. One of those is that some students can stay home. We can deliver educational materials to the home, study and test at home, and transmit results back to school.

That doesn't mean that we shouldn't have classrooms. Children need the social development and lots and lots of the activities that go on in the classrooms. Some kids learn better in classrooms, but others don't. To use my own son as an example: he likes to learn privately and he won't stay on task when there are a lot of other things going on around him. But when he's home alone in his own room surrounded by familiar things, that's the time for him to be doing the intellectual tasks needed to master the curriculum of elementary and junior high school. So the educational content should come in an interactive way to his home. He will learn a vast amount faster than he could in the classroom. The computer system that makes this possible includes a stand-alone microcomputer with communications at home and a central time sharing at the school.

Of course, the whole community of homebound, physically handicapped students and people who live in remote areas who can't get to a central classroom will benefit from such a system too!

Steffen: How about the very bright child?

Loop: Sometimes very bright people have the same kind of figure ground problems as LD people and may not be able to adjust in the classroom situation. Often they are teased by the other kids and are starved for contact with other very bright people. You can go beyond your own classroom, or your own town, or your own state with a computer network. Tom in Ohio, and Joe in Florida, and Sue in California, and Joan in Massachusetts can all join together in mutual study of an esoteric subject. Gifted kids can work long-distance with one another over the computer networks. They can pursue their interests and share resources without the teacher having to hover over them. Yet they can be just as responsible for showing results to the teacher as they would be in a traditional classroom. Their computer-based lessons and conversations can be recorded so that the teacher can review what is going on at leisure.

Another characteristic of very bright people is that their timing may be different from the normal person. A lot of very bright people are night owls who find a 9 A.M. class to be a real imposition on their circadian rhythm. If you are working on a computer network, you can carry on an asynchronous conversation. You type in a message at 4:30 A.M. and your teacher picks it up at 9:30 A.M. The teacher responds to it when the student is fast asleep. Then at 11:30 A.M., the student rolls out of bed, picks up the message, and says, "Ah, I was supposed to be studying tree bark and instead I've been looking at the formation of leaves. I'll spend the afternoon reviewing the tree bark lessons and then take the tree bark test."

The computer medium can free people to be themselves more. It may mean that the teacher can say, "Heck, I'm not a specialist in tree barking." But down the road there's an agricultural company that employs a tree bark scientist. This gifted student needs to be in contact with her mentor. So, Ms. Scientist can use her terminal at work and log onto the school's computer and become the teacher. It takes much less of the specialist's and the student's time to converse via the computer network than it would if she had to leave work and come over to the school and go through all the administrative rigamore in order to help the student.

Similarly, you can do a lot of recordkeeping and administrative work via computer. You don't have to have the student's physical body in the classroom. The student may be able to be an apprentice to the scientist. (Science seems to be an easy example for gifted kids, but it could be an artist, an opera singer, or a mother. I think the nurturing and home care are extremely important specialist skills that our society and our educational system ignore. Sensitivity to infants and providing a rich environment for infants are things that we don't even think about in our educational system.) If you're learning in the environment--the school keeps track of what you are doing and makes sure that you are meeting minimum curricular requirements. You can give the feedback to the school via computer and the school can give you measurement scores and direct your studies. All the time you can be in an environment which is rich in providing real learning, not just textbook learning. This is all quite different from putting in a fixed amount of time in a fixed schedule learning exactly the same thing as the 30 other people crammed into the classroom.

Steffen: What happens to the classroom? Do they still exist?

Loop: They still must exist. The traditional classroom is a speciality environment for certain kinds of learners, and it is really an excellent situation for them. If we were to do away with the classroom we would be saying, "We're no longer serving this set of learners." It's easy to tell who they are. They are often female, 7 to 14 or 15 years old, bright, and social. They are extroverts, and a classroom of

30 other extroverts is really a reinforcing environment for that kind of kids. (There are also boys, but I was just trying to paint a caricature of the person who thrives in a classroom.)

So, we've got to have classrooms for those people. Also, we've got to have face-to-face environments for activities which can't be taught via computer, chief among which is working with people. I think we need to set up situations which are like classrooms so that people learn to get along with one another. A restaurant is a social situation. You have to be able to handle yourself with other people. You can't teach physical grace, you can't teach manners, you can't teach rhythm and flow of a spoken conversation unless you are in a person-to-person environment.

There's much that can't be learned through a computer. You can learn abstract facts of chemistry, but you can't learn to pour a liquid from one decanter to another without spilling it if your only experience is with keyboard and screen. You can't learn to play soccer on a computer. You can simulate a soccer game on a computer system and you can learn the rules and theoretical strategy, but you see things as if you were a crow sitting in a tree. You don't coordinate your muscles. You don't get the excitement of your teammates screaming. You don't get the feeling of team play.

You have to really look at the things we can do by ourselves and the things we do face-to-face. Technology is changing the cost of doing things. It's going to be much cheaper to deliver messages to the home or to a community center than to bring people together to buildings that are used only eight hours a day. A classroom in a school is going to become a premium, expensive institution. Computer communication systems are going to be the cheapest way of distributing information to a large number of people.

There are dangers here. If we let school administrators opt for the cheap way, as they often do, we're going to lose the ability to have students get together to present a drama, or get together to sing or play sports. We're going to say, "That's too expensive for the school to do." What a tragedy!

We need to look at what can be done in classroom environments, what can be done in independent (one student/one terminal) situations, what can be done in small groups and in cross-country interactions. Then we need to slice up our curriculum so that we know what environment support what kinds of learning experiences. Then we can stand up at the school board meeting and say, "I don't want to sell the playing field. Our kids need team sports." Maintaining playing fields is going to be much more expensive than providing organic chemistry courses via a computer line. Taxpayers may not be as willing to pay for such expensive "frills". In our place in history at this moment, it sounds strange to raise such issues but they are going to come our way and we are going to have to address them in the next ten years. If we start thinking about them now, we'll be able to make rational decisions. If we don't face reality and decide what's valuable to us now, we're not going to be prepared to make the decisions when the need for decisions is on top of us.

Steffen: I hear you say that the curriculum that we have now--Science, Social Studies, Math, Reading, and Spelling won't be taught in the same way in the curriculum in the future. I'm also seeing big changes in the teacher's role.

Loop: Right now when you say the word "teacher", you mean the person who stands in a classroom and interacts with a relatively large group of people whom you call students. One of the major functions of the teacher is to funnel information to this face-to-face group.

I think we are going to see a whole lot of different specialty roles, all of which are called teaching. One of them is the "content specialist", whose main contact with students is via a computer network. They're the ones who will say, "Okay, all kids who are enrolled in my class are going to log on to my simultaneous computer conference at 11 A.M. on Thursday. We're going to have a conversation and debate about trade tariffs." Whereever they are at 11 o'clock--some of them will be at home, some of them in daycare centers, some of them will be in libraries--the students will all get to a terminal, log on, and the computer will shuttle them into a common conversation. They'll have a conversation and debate--a seminar. You won't have the expense of getting the people together in one place. These teachers are network specialists. They have the content and the communication networks as their "curriculum".

We will have other people who are "face-to-face specialists". They know how to create classrooms and daycare centers which are healthy places to be, where people are happy, relaxed, and growing. Their pupils learn social skills. These teachers are not going to be burdened with delivering calculation skills or algebra. As far as the society as I am describing is concerned, the ability to be together, to communicate, to problem solve with other people is just as important as the ability to calculate.

So they attend classes in school or daycare centers. Now they need to have a PE class. Part of the daycare's or school's responsibility is to make sure that kids get to have face-to-face experiences with other people--soccer, for example. So there's a "sports and physical development specialist".

Next we need "individual counselors". In our society now, we learn to deal with our own personal fears, hates, and miseries when we are between 20 and 35. That's when most people go to psychiatrists. There's no real reason why we couldn't learn to deal with our anxieties at a much younger age. That should be a normal part of education and would probably create much more effective academic students. Further, almost never do we study the kind of personal talents children have, what their intellectual strengths and weaknesses are, and what their interests are. We should be teaching everybody how the human organism develops.

(Midline integration is a good example. 99% of the people in the world don't know that they are going to have trouble reading if their eyes jump when they cross the midline of the body.) We should help people to take responsibility for how and what they learn, and how they can optimize their strengths and accommodate consciously for weaknesses. We need specialist teachers to help people learn how to learn. Right now our school environments are so difficult to learn in. We are struggling to transmit to kids very elementary, often trivial concepts. We are making learning hard. If we would step back and look at what we need to learn, I think we'd find that about 80% of the curriculum is not terribly important in the long run.

Steffen: So computers are going to make different kinds of learning available to kids, not just memorization?

Loop: The computer does make it possible to deliver messages cheaply to a lot of different places. The word "lecture" means reading. When our technology was such that a book was very, very expensive, we developed the lecture method. The person who could read, the person who had the book, stood up in front of a large group of people and read the book. That's why we have lectures. Today's technology allows us to deliver information to a large group of people in quite a different way.

We've got to stop and look at the reason we developed these structures (such as lectures). We need to realize that technology has changed. We need to ask what new structures are possible. Then we make value judgments. The computer is never going to make a value judgment as to whether we ought to send a certain message to the home or require people to come together at school to receive the same message. All the computer does is make it possible to send some messages to the home or to the school. People still have to make all the decisions. If we let ourselves be driven by technology, we are going to make gross mistakes. I think the 9 A.M. to 3 P.M. classroom for all children is one of those gross mistakes. It was driven by technology that is not operative anymore. As a taxpayer, I really resent having to pay for it.

Steffen: One of the questions that people are asking at the moment is what computer should I buy? It might be nice if they were deciding what they wanted to teach, but a lot of them don't have that opportunity.

Loop: It never occurred to them that they were able to choose what they could teach--that they do choose what to teach by what they emphasize.

Steffen: Right. Given that a lot of schools have bought hardware and are wondering what to do with it, what would you suggest that people invest in? What kind of software would you recommend?

Loop: That's the question I won't answer. By answering that question, I deny my own thesis. But here's an example: say I'm talking to an individual teacher. My first question is, "What's your worst problem? What is making your life miserable?" In this case there are one or two kids who are taking a huge percentage of your time and keeping you from being with the rest of the class. I recommend that you buy a cheap programmable video game. This may or may not help that child's education, but the classroom is not helping the child's education anyway. If you can get that kid off your back you will be able to do a much better job for the other 32 kids you are supposed to be serving. In a way this is a copout, but we are talking now about teachers, people who are in charge of the environment in the classroom, and we need to solve their problems. If your problem, as a teacher, is that Johnny is taking up most of your time, disrupting and disturbing you and the rest of your students, then get Johnny occupied. Johnny will be delighted to spend hours dealing with a machine rather than dealing with other kids. That's probably the reason he's being disruptive in the classroom in the first place--he can't deal with other kids.

Another example: suppose all of the stupid reports that today's bureaucracy requires are keeping you from helping your students. Then, for God's sake, don't give the computer to the kids. You're the one who needs to be bailed out! Get yourself a word processor and a couple of support programs that let you do grades and reports and IEP's and all that stuff faster than you can do it by hand. Then your paperwork burdens are lightened and you can be there for the kids.

If you've got a group of kids who want to learn programming and if learning programming is something you want to do, use the computer as a laboratory to learn programming. There's no reason why you shoouldn't learn programming. Start with something simple, like printing the first whole numbers and their squares or printing pictures on the screen.

The computer's not a panacea. It's not going to solve all the pedagogical problems in the world. It can only repeat the solutions that we figure out. If the problem is that you're tired of standing by the ditto machine running off 20 addition problems or if you are tired of figuring out what 20 problems you gave them yesterday, you can write a little program which will do the job for you. It will make out 5,000 unique ditto sheets and print them out for you. If your kids are cheating, you can give a different problem sheet to each kid, so that no two kids have the same ditto sheet. Teachers do that now. Do what you are going to do, but let the computer help you do what you want to do.

Steffen: So we are still faced with decisions in the classroom about how children learn and how we can best facilitate that learning.

Loop: Always will be. We're never going to change that. There's no way that that electronic idiot box is going to know anything about how kids learn. The only time a computer knows is when somebody else who knows has written a program to tell the computer what to do. The box doesn't know anything.

Steffen: So we as teachers are choosing software on the basis of our own knowledge. Are we likely to choose the same kind of software that we find in textbooks in classrooms at the moment?

Loop: If you happen to be that kind of teacher, sure. If you're very satisfied, if you like the current curriculum, then use the computer to deliver it. There are lots of kids who will happily do drill and practice for probably 10 times longer with a computer. Thus they will get 10 times more time on task with exactly the same drill and practice content. If that's what you want to do with kids, the computer makes it much easier. If you relieve the teacher of the task of handing out the ditto sheets, and correcting them, then the teacher can focus on more important issues, such as helping the child to see the problem in another context. Generalization and transfer of skills is a major area which is neglected in lots of classrooms. There are lots of kids who can perform on a test, and then many walk out of the classrooom and forget everything they ever knew. Thinking is very context dependent. It's the highly intelligent person who can transfer his or her abilities from one environment to another. That's an important issue for teachers!

Steffen: We are doing a lot of things in the classroom that we call "back to basics". What can we do for kids now to help them cope with a future that seems to be so rapidly changing.

Loop: In the industrial society, one major area of employment was machine control. A typist served as an interface between either the spoken (dictated) word or the written word to another written word. Essentially the human was serving as a filter moving a message from one medium to another medium. The human was not doing any creative thinking. Almost all assembly line jobs are like that. In the pre-industrial society, we needed human beings because they had muscles. In the industrial society, we needed human brain power to do "if-then" thinking. Traffic control activity with cars and factory assembly line work are "if-then" procedures. Originally, the traffic cop stood out in the middle of the crossroads and decided who should stop and who should go. We replaced him with a timed set of lights, which didn't take into account how many cars were lined up on each side. The light was red for so many minutes, and then the traffic light switched color. Now we can replace the traffic cop with an intelligent set of lights which can do the "if-then" logic. If there is a car coming in Direction A and none in B, then set Light A is green, and Light B is red. If the number of cars stopped at B is greater than the number of cars stopped at A, then change the lights and so on. Now all of those people who were simply serving as "if-then" controllers can be replaced by machines; by computers.

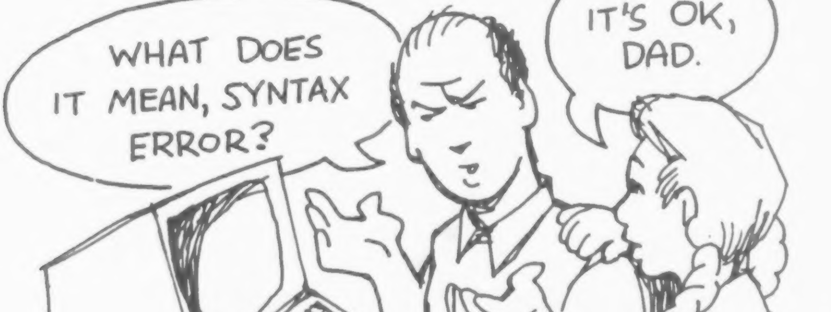
We need to teach people to do something higher than using their muscles (pre-industrial) or interpreting "if-then" control situations (industrial). We need to be creative. We need to know how to play. That means we need to know how to occupy our time, because we don't have to spend as much time doing routine tasks. We can no longer say it's okay to sit there and type. That job is expensive for a human to do but very cheap for a machine to do. American Express has a machine which can read 2 billion pieces of information per second!

So we need to learn to be uniquely human. Creativity and problem solving, as opposed to solution repetition, are the skills that machines can't do. We need to be nice to each other. Machines can't do that either!

I think we are going to find a tremendous rise in the importance of learning and the importance of people learning to be with each other peacefully. It's not going to be cost effective to spend our time teaching people how to be typists and assembly line workers because we are not going to get away with training for one job, which we keep all our lives. The jobs will change, and as we learn how to do a job, we will also learn how to make a machine do it.

So we need to learn, and continue to learn. It's absurd to think that education starts when you are five or six. We learn more between 0 and 5 than in all the school years. It's similarly absurd to think that once you get to be 18 or 22, or even 30, your education is finished. My husband and I spend large numbers of hours studying and problem solving. We are paid for that. We get paid for learning. We get paid for thinking, as opposed to being paid for doing. Right now the child who fills out the ditto sheet quickly and accurately and robot-like gets a higher grade than the child who looks out the window and thinks of a new way of solving the problem. We have annals of history filled with creative people who failed school. We are still failing them. You'd think we could learn.

Steffen: We need to learn.


WHAT DOES IT MEAN, SYNTAX ERROR?
IT'S OK, DAD.
SG

MIKE AND COMPUTERS

C. A. Seibel

Some kids are bored with teachers, with text books, with the classroom. Educators are constantly searching for motivational gimmicks to help stimulate the students' thirst for knowledge. The computer is the handiest, dandiest, motivator around today. If you don't believe me ask Mike, an eight year old boy from Cahokia who was born with a rare and crippling skin disease called Epidermolysis Bullosa. The slightest touch to his fragile skin causes blisters that from time to time cover his entire body. Every day of his life brings the same routine of blisters, pain, and the constant threat of infection. Even worse than all this is the home isolation forced on him by his disease. He can't attend regular school. I met Mike when I was asked to be his "homebound teacher". Although his hands and feet are webbed together, and writing is a painful impossible task, Mike's mind is alert and most days I find myself trying to stay just one step ahead of him.

After taking a computer course from Tom O'Brien I decided to bring Mike to the lab and see how he responded. Mike was in awe of the many computers, keyboards and screens around and was totally absorbed in what everyone else was doing. Finally switching on his Apple II and putting in Educational Volume 7 Disc his attention was focused on his individual screen.

He played Caterpillar, Train, A is for Apple, Pictures, Words, Shapes, Smile, Wuzzle, and Spaceships. He played each game one right after the other without stopping for anything.

The child was fascinated by the games and couldn't wait to get to the next screen game. I only wish I had taken more notes on his responses. He was delighted with the personal notes in some of the games. He said "He knows me!" He also said he felt like the computer was clapping when he gave a correct response. The positive reinforcement was great. He thought playing together was fun. All afternoon he kept saying "What's next?"

Gertrude's Secret was his favorite. It was the first one we did in vivid color. As a student in O'Brien's class, I had pondered long and hard and struggled to get through the secret of Gertrude's game. Mike whizzed right along. (He did need some help reading some directions along the way.)

We stayed for three hours on our first trip and have been back several times since.

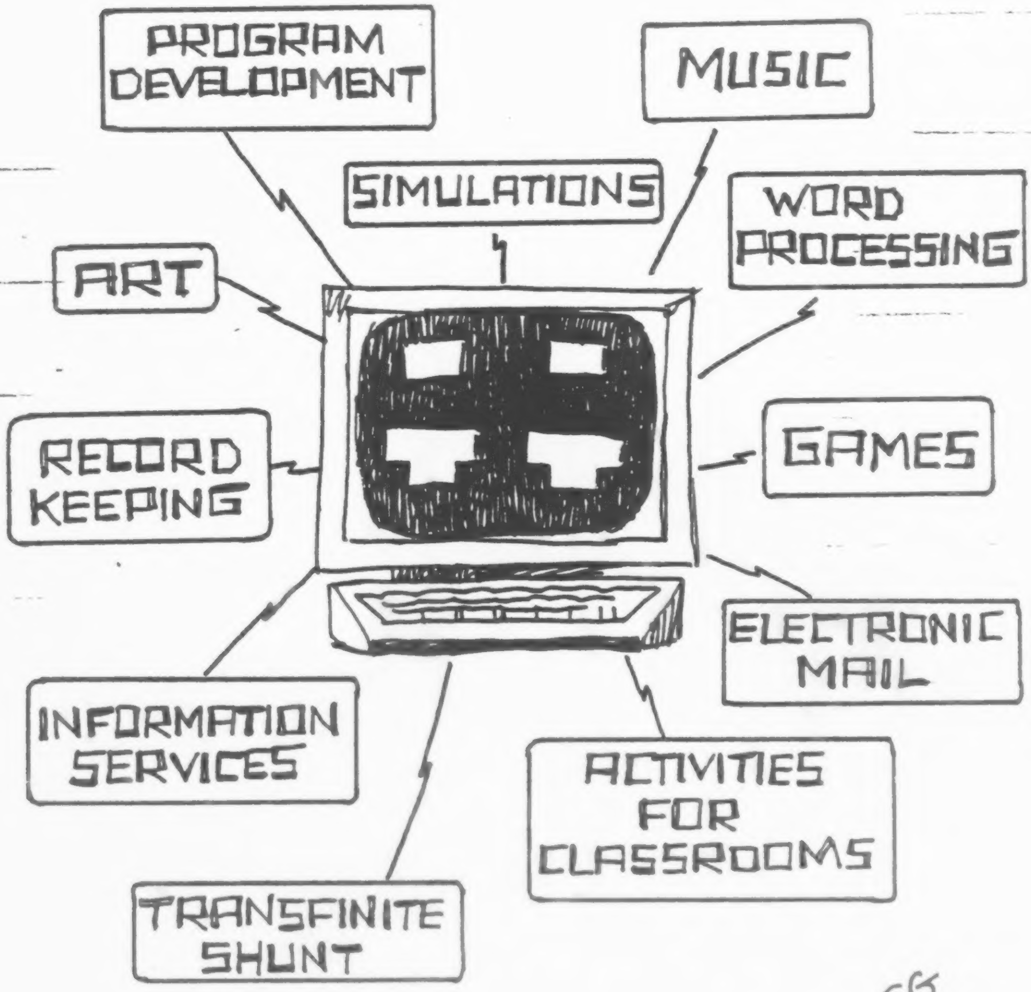
I feel that computers are opening a whole new field to all people, especially the physically handicapped. Up to this point, they have had few opportunities to react to a responsive individual in a learning situation. Mike can think things out that are graphically presented to him. He has a very limited reading vocabulary but his mind is quick and alert and he's always eager to solve a problem that interests him.

So I think that computers have earned a solid place in the educational world of children. A computer program can have the flair, imagination, and hynotic attractiveness of a video game and we all know how American children feel about video games. It's even better with educational software; the computer can be programmed to respond to individuals and give them personal and positive interaction.

Teachers need helpers. Students thrive on one-to-one contact. A computer can give to individuals what a teacher lacks the time and energy to give.

Let's face it...Computers are here to stay..Thank God!

I think that Mike would agree.


PROGRAM DEVELOPMENT
MUSIC
SIMULATIONS
WORD PROCESSING
ART
RECORD KEEPING
GAMES
ELECTRONIC MAIL
INFORMATION SERVICES
ACTIVITIES FOR CLASSROOMS
TRANSFINITE SHUNT
SG

SHARING MY LEARNING EXPERIENCE

Mary Ann Straughter

After completing my Computer Software course, I was motivated to continue to learn about computers - even to learn something about programming. I would like to share some of my new ideas. First, the computer can be an appealing learning medium for some students. Second, the computer should be introduced to students as a serious tool they can use in their lives right now - not as something they'll need later on. Finally, computers can be valuable tools for developing problem solving skills and independence. These skills go far beyond any that would be gained from any text book.

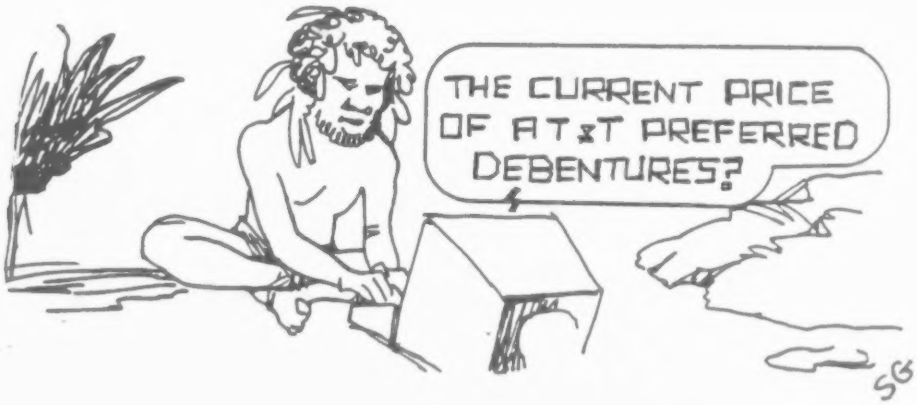
The attraction of computers for adults and children is the feeling of control that comes with programming - or even just operating it. It's a powerful tool that serves one's own purposes. More important is its ability to put the student in charge. School gives students knowledge and skills. Rarely does it teach them to take charge of their own lives. The most important property of the computer is that it can be made to do what you want it to do.

Because of this course I have gotten some hands-on experience with the computer and its software. Even with my limited experience with computers, I know computers can teach some of the desperately neglected areas of the traditional curriculum; that they can indeed, teach the skill of inquiry and problem solving (never properly addressed in the lower grades); and that eventually, they will help educators renew their enthusiasm for teaching.

To me, the central problem of computers in education, once we have achieved some kind of equity of access for all students, is whether we use computers to deliver the same thing being taught in the classroom or whether we profit from the original power of the machine to enable students to learn in new ways that are not only motivating, but also better for learning and teaching.

If you would like to stay abreast of this rapidly growing trend in education, I would suggest going to your nearest library and reading the Classroom Computer News. After reading a few of the current issues I guarantee the knowledge and enthusiasm you will get from it. Because Classroom Computer News is written by educators, it shows a special sensitivity to the problems both solved and created by the introduction of micro-computers into the classroom. Because this magazine is current you will get all the latest news on products, grants, research and computer programs. I really like the idea that it doesn't just report the news, it examines the human factors.

Note: Classroom Computer News has been retitled Classroom Computer Learning.


THE CURRENT PRICE OF AT&T PREFERRED DEBENTURES?
SG

NURTURING THE SEEDBED WITH WORD PROCESSING

Connie Funkhouser

Word processing has been around for some time in the business world. As a teacher who has been too long in her ivory tower, the classroom, and as a result has denied herself the knowledge of tremendous advancements in our modern technology, I was completely amazed during a recent demonstration of a word processor. I felt the excitement that must have prevailed at the invention of the wheel.

What is a word processor? This was a question I secretly asked myself on a number of occasions when I heard the term mentioned. Finally, on the second day of a summer computer workshop in which I was enrolled, curiosity prevailed over pride. After the instructor had thrown around the term a number of times that morning, and I had exhausted all possibilities of defining the term from contextual clues, I courageously, but with innocent candor, asked the student next to me, "What is a word processor?" To my utter amazement he said, "I dunno!" So I am not going to make ANY assumptions.

A word processor is a computer program that comes in the form of a floppy disc or a cassette, depending upon the type of computer. It allows its user to type words, sentences, paragraphs, etc. on the keyboard of the computer. The typed material appears on the monitor. In order for word processing to be completely functional, a piece of hardware called a "printer" is necessary. This produces the finished product, one's thoughts on paper.

What makes this so special? Can't a typewriter do this? Word processing has unique editing features that make revision much easier and enjoyable. Words can be deleted, replaced, transferred, changed, spelled differently -- whatever the operator wishes. Simple directions for making these changes are easily learned. Entire paragraphs and compositions can be moved at the operator's discretion. Word processors often come with "word banks", a list of 20,000 to 30,000 commonly misspelled words. Should the typist misspell one of these words, the computer calls attention to the error and then makes the necessary correction.

We know what this has done for the business world. What can it do for the elementary and secondary student? Its uses are unlimited. But more important, what effect will it have on their writing?

Students just may begin to enjoy writing. Many students despise revision. They look upon it as a form of punishment. They didn't get it right in the first place, and now they have to do it again. But with a word processor, editing is so much easier. Careful, frequent revisions are no longer the chores they once were. Teachers tell us that students tend to be more prolific and fluent. Also, remember, only the corrections and changes need to be retyped. Prior to word processing, the entire composition needed to be redone. Revision becomes true revision and not just busy work.

Students may not only begin to enjoy writing, but as a result, become better writers. They will begin to take pride in their neatly finished product. No scratch-outs, erasures, deletions, or smudges for the inexperienced writer. Even the "hunt and peck" typist looks good on a word processor.

Not only is the student nurtured by word processing, but the teacher benefits too. Suddenly she has a more efficient way to type letters to parents, do collective group writing with the class, and produce error-free ditto masters for lessons and tests.

Now it may come as a complete surprise that I have labored long and hard over this essay, eliminating, selecting, deleting, scratching out, changing, editing. But, through it all, one thing is obvious to me - how much easier and enjoyable this task would have been with a word processor!

HAVE YOU SEEN THE NEWEST MICROMODEM 507?
SG

THE SCHOOL: COMPUTER COUNTRY

Virginia Small

In this age of computers we have newer, faster, and more accurate access to all kinds of information. It is encouraging more schools to make computers available to more students of all ages. The use of computers in schools has been lagging for many reasons -- money to buy hardware, lack of teacher confidence in using the computers, teacher's fear of being replaced, and possibly the overall realization that many students are already proficient with computer usage.

One of the main thoughts should be, "Can computers help teachers prepare children for the 21st Century?" What types of skills will they need to know to help them adjust to their future world? Children of all ages can think or try to visualize what the world might be like when they are adults. What types of transportation do they think they will have? What medical advances do they think possible? How will industry and world trade change? Will use of energy change? Is there a possibility that new sources of energy will be discovered? As better technology is needed in the future students who have developed the ability to solve problems will be better able to find solutions. What part will teachers and computers play in this new form of literacy?

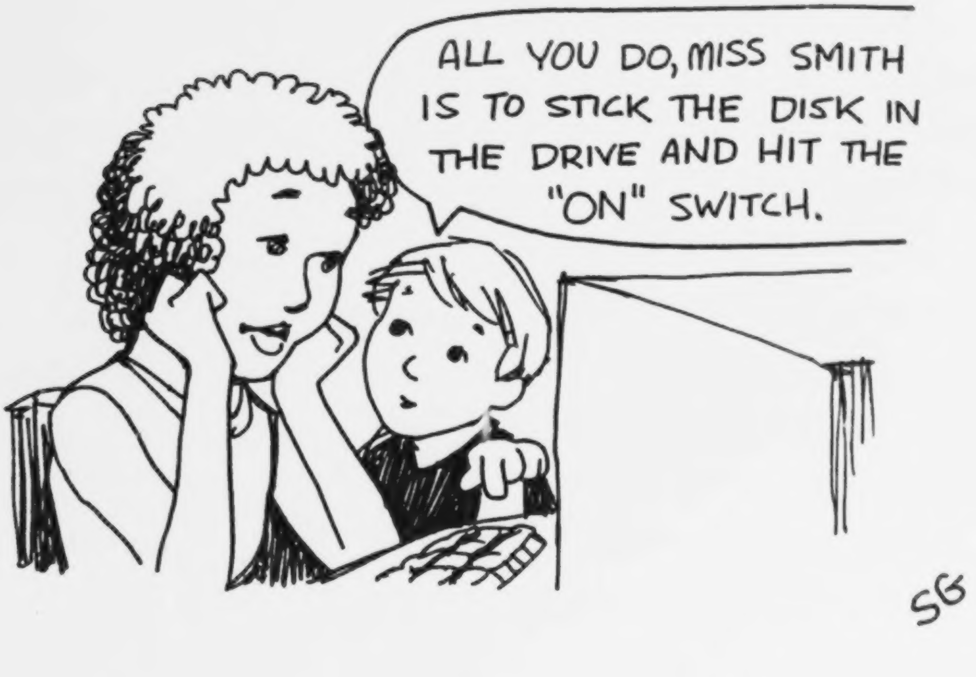
As computers and software are flooding the market as well as constant changes in both, schools and teachers are overwhelmed with wise decision making in purchasing either or both. One important fact needs to be accepted and that is there will continue to be changes in hard and software and our acceptance of this will help our attitude. Learning is a continual process that will become even more important as we move toward the 21st Century.

Accepting the fact computers will continue to improve let's look at the software. What important issues should we see in software? T. C. O'Brien states that one of the chief goals in software is the development of complex thinking. How is this achieved? Software that uses problem solving skills will aid in this goal. The trick is to be able to view software and decide if it is going somewhere. What problem solving skills should a student be called upon to use? Some of the problem solving skills include memory, sequence, regrouping, visual associaiton, discrimination, information gathering, successful scanning, analyzing, estimating, projecting, problem solving, etc. Software that involves one or more of these skills will probably go somewhere with the child's thinking.

I have just spent some time reviewing software. I'm sure I experienced many of the feelings children have or will experience. There is both excitement and fear when first using the computer. The excitement stems from doing something new and the fear stems from thinking you will appear dumb. This is especially true if the computer wants to know your name and at the end of the game states the number right out of the total. I enjoy the game more if the name used is "Kid" or "ET". I imagine many children will feel the same way when they begin. As confidence and success are felt the child will be willing and capable of going on to more challenging programs and will be proud to add his or her name to the program.

Many schools around the country have found the use of computers a valuable aid to increased interest in school. Some schools have felt assisting parents in computer usage has been beneficial even to the point of renting the terminals to parents over the weekend or over school holidays. A school in San Francisco's inter-city had a declining enrollment and a possibility of school closure. In an effort to attract new students the school developed a plan for computer instruction and the lease-purchase of eight terminals. Later eight more terminals were purchased. Not only teachers and parents were really taken to the computers but the children were showing enthusiasm for learning. A private school in Dallas, Texas was a test school for the Massachusetts Institute of Technology. MIT had developed Logo, a children's computer language. The students and teachers were taught basic commands but learned by experimentation after that. The children discovered on their own how to accomplish a variety of graphics. This hands on approach would certainly be a great delight to Piaget. Logo was not designed by computer scientists, but by a group of people whose major interest was learning. Seymour Papert was one of the researchers who had worked with Piaget and knew he believed that children learned best when taking an active role in trying to understand their world. Logo is the computer language that could create this type of learning environment.

As I continue to review software I will try to keep in mind what does it do and where does it go. Is the program worth doing at all? The material used in the software doesn't have to follow the curriculum, it should go beyond. As I observe the children using software I hope to listen to their comments. Are they engaging in the issue in a sensible way? Are these children more willing to tackle new problems? If this is true I shall feel I have taken the first big step in preparing children for the world they will live in as adults.


ALL YOU DO, MISS SMITH IS TO STICK THE DISK IN THE DRIVE AND HIT THE "ON" SWITCH.
SG

COMPUTER AS AN AID IN REDIRECTING EDUCATION

Jill Frey

American public education has become the center of public criticism and debate. One of the major criticisms has been the larger number of graduates who lack the skills to deal with daily living and work experiences.

Today's educational system was developed during the birth of this country's industrial age. The system was structured to simulate the factory environment and thus train the student to be able to function in that environment with the following skills: basic academic knowledge, ability to be punctual, obedience to supervisors, and the perseverance to do daily rote and repetitive work. To accomplish these tasks educators developed the following standardized items: subject curriculums, achievement and intelligence tests, grading policies, admission procedures, and program accreditations.

Current societial and business changes have been moving towards increased individuality, diversity, and decentralization. Individuals entering the labor force today need to be flexible, articulate, creative, cooperative, have a diversity of skills, and have the ability to organize and interpret information in order to solve problems.

In the national committee's report on American education the committee recommended that schools include a course on computer literacy at the high school level. The computer has become one of the most important and powerful tools that humans have developed. To limit their use to high school literacy courses is limiting educators and students in using the computer to its full capacity. The computer can be used at all levels of education as a tool to aid in the development of a variety of skills. The computer alone cannot teach the new skills which students will need; however, when combined with changes in curriculum, classroom structure, and teaching methods, students will begin to acquire the new skills needed to help them function in society.

During recent years the software industry has developed many excellent programs which may be used to aid the educator in his task of preparing his students for the future. Programs have been designed to be used for individual, group or classroom instruction. Drill and practice, tutorials, educational games, simulation, testing, and inquiry are the main types of programs available for classroom use. As an educator one must keep in mind that the computer is an aid to one's program and not a replacement.

The educator may use the computer in different ways with different students. For the student who needs help in acquiring skills already taught, the computer is a motivational tool which is non-threatening and gives instant feedback and rewards. Other students in the classroom may be using it to teach themselves a new skill or new information which will not be presented to them in class. Finally, the computer can create learning experiences which are difficult or impossible to provide for the student. By using inquiry and simulation programs the students use new and previously acquired knowledge in solving the problems presented in the program.

The inquiry and simulation programs are the most powerful and helpful to today's students. Knowledge is of little value if it cannot be utilized in new situations or in a form different from that in which it was originally encountered. These programs provide experiences in sorting and organizing information, testing hypotheses, and finally discovering solutions.

The computer can become a tremendously helpful tool in aiding educators in providing the new skills which our students need. It allows the teacher greater flexibilty in providing instruction to students of all abilities and provides students with experiences in creating problem solving stratagies, cooperation with others, and familiarity with the capabilities and limitations of the machine. The computer thus will become one of the new components in developing American public education into a stronger and more appropriate system -- a system in which students will be taught information along with reasoning and occupational skills which will allow them to succeed in future endeavors.

DO YOU HAVE ANY FLIMSY ...ER... FLOPPY DISKS?
SG

COMPUTERS ARE COMING! COMPUTERS ARE COMING!

Jean Eckert

The children who enter kindergarten in the fall of 1983 will be graduating from college and entering the world of work in the year 2000. What will the world of work be like in the twenty-first century? Will the skills being taught in my classroom prepare children for life in the next century? To gain a bit of perspective, one needs to look back to the beginning of the twentieth century. Could anyone in his wildest dreams have envisioned space travel, nuclear energy, laser beams and the electronic marvels we find common today?

It is a fact of life that the technological revolution has been going on for many years now and, like them or not, computers are here to stay. The impact that computers will have on education will depend to a large extent on their acceptance by educators at all levels who are in the field now. Computer literacy training for classroom teachers must be vastly expanded. Teacher training institutions will need to be instrumental in making teachers aware of the wide range of uses for computers in education. Getting computers into the classrooms will not be as difficult a problem as getting trained people who know how to use them effectively to achieve the maximal educational benefits. Teachers everywhere will have to take their heads out of the sand, overcome their fears and "just try it".

Since the whole computer industry is a very lucrative, wide-open field, companies will be getting on the bandwagon with many different kinds of computer software. Educators will have to choose wisely, selecting software to meet their educational goals.

The basic question must be, "What can a computer do better than our present educational practices to help achieve our educational goals?" Will the computer help achieve more effective learning by saving time for students or teacher and afford more individualized instruction? Will it make learning more fun and thus motivate children to learn more in less time? Will it become possible to deal with issues that before now were not possible in the classroom?

One of the complaints of most teachers is the tremendous amount of time spent on record keeping, particularly with individualized instruction. Computers can store and instantly retrieve all sorts of information about individual students (test scores, health records, etc.)

The wide range of computer software designed for use with children offers a variety of educational experiences. Students are bored, bored, bored by the dull page-by-page lock-step instruction offered in most classrooms today. Computers can provide simulations, graphs and models not possible in printed textbooks. Computers can offer to children a means of inquiry and dialogue not possible with the thirty to one pupil-teacher ratio in most classrooms. Some computer programs have built-in teacher options, so that the teacher has control of the difficulty level of the lesson. Computers can be used with individuals or small groups equally well.

Another advantage is that the user receives immediate feedback from the computer. In most cases incorrect responses must be corrected so that a program can be successfully completed. The computer is infinitely more patient than most teachers.

Getting the maximum educational benefit of a computer program in our school will involve proper planning and division of responsibility among teachers, administrators and the board of education. Since no funds are available for any new or extra equipment, budgeting will be a top priority. Those teachers who have a limited computer awareness will need to encourage as many other teachers as possible to become familiar with the computers and to take basic computer literacy courses. The next step will be visiting other schools in nearby districts that have successfully instituted computer programs and setting up a pilot program.

Planning must also include scheduling the students to achieve the desired level of computer literacy. Should all K-4 students have access to use of the computers or should it be limited to certain grade levels? This decision will influence the type of software needed. Determining whether the computers will be used for instruction, remediation or enrichment will affect the choice of appropriate software.

The following guidelines for choosing computer software should be followed to insure getting the most value for the money. The software should be accident proof. If a child accidentally punches the wrong letter or number key, the program should not be affected. The directions must be simple and easy to understand and should be presented through the computer in an interactive mode. The student should be able to go back to the directions easily. A continuously displayed instruction frame is very helpful. The program should provide help following an incorrect response, such as asking a question or restating the directions. When non-readers use the program, voice synthesized instructions are helpful.

It will be essential to have someone oversee the computer area -- someone who understands what to do in case something goes wrong. One of my observations is that programs do not always run when the disk is inserted into the computer or the computer may malfunction. This can be very costly. Most computer companies have a "hot line" service.

To perform efficiently at the computer, students will have to learn the arrangement of the character and function control keys on the computer keyboard. Those children who know the letters may benefit from practicing on a standard typewriter. Puppets could be used to help younger students learn the instructions. There seem to be very few computer programs available on the kindergarten or pre-school level. Most programs require the student to be able to read the directions. There are ways around this, of course, but computers do have to be used differently with non-readers (e.g. in small groups or with a helper).

WHAT IS LOGO?

Donna Yunker

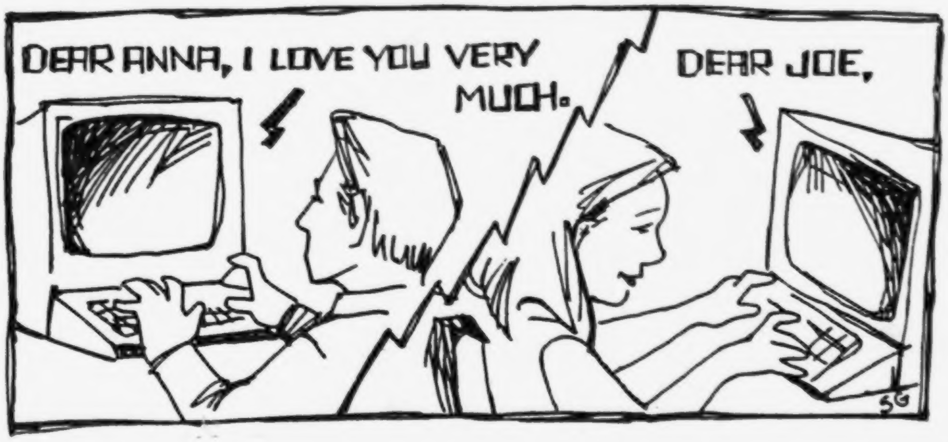
Just exactly what is Logo? I have asked that question many times and I usually received the answer -- it is a computer language using a turtle. However, after spending several hours reading about Logo, I discovered that there is more to that definition.

It all came to life when I observed the classes at SIU-E Computer Camp for children ages 7 to 12, Summer, 1983. I was amazed at how quickly the children (grades 2-4) learned the turtle commands. It was truly exciting to see children work with Logo. Not only did they learn the turtle commands but even those who had never had geometry were figuring out how many degrees to turn the turtle. Learning to move the turtle was more than trial and error, it was trial and revision. If a series of commands did not produce results the students expected, they simply figured out a better procedure.

What is Logo?--Logo is a relative newcomer to the group of programming languages. It was developed in the late 1960's by Seymour Papert and a team of researchers in Cambridge, Massachusetts. In 1970, the Logo project moved to the Massachusetts Institute of Technology (MIT) Artificial Intelligence Laboratory. Logo is best known for its graphics, created by moving the turtle. Seymour Papert developed this computer language to help people become better learners. Logo gives the person an opportunity to work in abstract thinking by relating new ideas to concrete experiences with which they are familiar. And, Logo allows students to create and name their own commands.

There are two special features of Logo. The first is its list-processing language. This enables the users to freely organize the information in a manner that best suits their needs. The other feature is called recursion - a programming structure in which part of a command's definition is the command itself. As a result, you have a command that repeats itself. Other programming languages have this feature but Logo accomplished it with surprisingly brief programs.

Logo is one of the best ways to introduce a child to a computer. It is certainly an exciting computer language to learn and/or observe. If you have the opportunity to observe or learn Logo, do not pass it up.


DEAR ANNA, I LOVE YOU VERY MUCH.
DEAR JOE,
SG

HOW COMPUTERS HAVE CHANGED OUR LIVES

Gloria Dismuke

Computers are invading virtually every aspect of life in America. They are changing the way we work, play, and even think. That they have affected the lives of nearly all of us is indisputable. Their impact has been experienced in areas as widely separated as space research and primary instruction. We live in a world that is increasingly dependent on computers. These machines not only calculate our paychecks and our bank balances, but they are invading areas where their application once seemed inconceivable. The physician may use the computer to diagnose a case, the attorney to research a legal matter, the policeman to investigate the records of an alleged criminal, and a history teacher to simulate the Civil War. It now seems improbable that any career will remain untouched by computers, as computers are penetrating directly or indirectly into nearly every aspect of human affairs.

The seemingly unlimited usefulness of the computer itself has been augmented by its rapid development. The number of computers produced has risen dramatically. In the early 1950's there were less than 1000 computers in existence. By 1976 the number of computers had risen to 200,000. This phenomenal growth is primarily due to the major scientific advances in computer design. In the early 1970's very low cost computer products began to appear and were called microcomputers. Microcomputers reduced the price of computers to below $1,000 and brought the computer into the small business, the home and into the educational field.

Let's look at some aspects of everyday life that we take for granted, but that would be quite different without computers. The financial institutions - banks, savings and loans, credit unions, and credit-card companies - would be unable to operate at the same speed or the same volume of business without computers. Consider the processing of a check. A customer writes a check in a store and at the end of the day the merchant deposits all the checks received at the bank. That part hasn't been changed by computers. What has changed is the speed with which the amount of the check is credited to the merchant's account and debited to the customer's. Before computers, the check was credited to the merchant's account by hand, the check was then sorted and mailed, or sent by courier, to the bank of the person writing the check where the amount was debited by hand. All of this could take three or four days if checks had to go to another town. All of this now, the debiting and crediting, is done overnight, so a check deposited before a certain time in the afternoon has been processed by eight o'clock the next morning. The check itself might still take several days to reach the writer's bank for filing, but that's not too important. Telecommunications and the high speed of computers have reduced the time necessary to process a check and at the same time have increased the volume of transactions that can be handled.

The telephone system as we know it would not be able to handle the communication load without computers. It has been estimated that to handle the number of calls being made today if manual switching were required would use one-half of all adults in the country as operators and would not offer as efficient service. Computers determine the best way to route calls across country, avoiding busy areas. Many large telephone exchanges also have computers that monitor their performance and regularly print out a list of problems for engineers to fix. Thus your telephone could be out of order for a few hours and then be fixed without your knowledge.

It is possible that airlines would be unable to offer all the flights they do without computer reservations systems. How could one determine if there were passenger space available on a flight leaving in an hour and make a reservation without a computerized system? As you can see, the nation's travel habits would certainly be different without computers.

If you are unfortunate enough to be hospitalized in an intensive care unit there is a good chance that you will be monitored by a computer. Patient-monitoring systems make continuous readings of vital signs and, in addition to creating a continuous record of changes in these signs, can alert nursing staff when vital signs exceed some predetermined limits. Such systems not only provide better monitoring than could be performed by a nurse at bedside, but allow more patients to be cared for by a fixed number of staff.

Finally, consider the role the various governments local, state, and federal play in our lives, through collecting taxes and disbursing it in various ways. The biggest collector, of course is the Internal Revenue Service. It is inconceivable to think the IRS could process tax returns without the use of computers, unless returns were submitted on a year-round basis and were less complex. The social-security system is the largest disbuser of federal funds. Again, it is hard to imagine how it could keep track of all the contributors to, and recipients of its funds without a computer.

There are, of course, hundreds of other ways in which computers impinge on our lives, education being one of them, and there is a tendency to accept all the applications of computers as good. It is important to take a balanced view of their impact, however, for there is always some cost involved in computerizing a system that was previously manual. And these costs have to be balanced against the benefits.

REFERENCES

Awad, Elias M., Business Data Processing, 4th ed. (Englewood Cliffs, N.J.: Prentice-Hall, 1975)

Dock, V. Thomas, and Edward Essick, Principles of Data Processing, 3rd ed. (Chicago: Science Research, 1974)

Stern, Robert A., and Nancy B. Stern, Principles of Data Processing, 2nd ed. (New York: Wiley, 1979)

WARNING! COMPUTER COMING!!

Carol Beste

The school year has just settled into its routine. As you work at your desk after school, the principal enters your room and announces you will be receiving a computer for your class in a month or so. You are to work it into your curriculum and find the appropriate software. What do you do?

DON'T PANIC!

A wonderful teaching aid is coming your way. A few DO'S and DON'TS will get you on your way.

DON'T be afraid of the computer. When it arrives, spend some time getting acquainted. DO find out how the computer works and what it can do. The idea has often been put forth that teachers need to be computer users, not computer programmers. You DO NOT have to know all about the internal workings of a computer. You DO need to be comfortable using a computer. DON'T feel threatened when a student knows more about the computer than you do. And they will -- very quickly! DO use their knowledge and ability to help you derive the most good from your computer.

Before beginning to select software, decide what purpose you want the computer to serve. If you are obtaining only one computer, you may think it is just going to be a toy. The students may think so, too. DON'T let this happen. Even with one computer, lots of good can be accomplished. DO use it in a variety of ways. It can be an effective remedial tool because it will hold the student's attention. It also gives immediate feedback. In these instances it can also help a student's self-image because his mistakes are known only to the computer. It can also be a very effective tool in challengging the high achievers to experiment with concepts. It's great for providing simulations. Group instruction can be accomplished by hooking up a TV set as a second screen (or more) so everyone can see.

The most important part of the computer is the software. It is often suggested that you decide what software will best suit your needs, then buy the hardware that goes with it. DO choose the software carefully.

You will soon find that reading a short summary in a catalog really tells you very little. The program may seem to be exactly what you are looking for, but when you see it, it can turn out to be a big disappointment.

You will find many programs that are nothing more than electronic ditto sheets, but with no place to do the work. It states a problem and expects an answer. The student will need paper and pencil. Better to use a ditto sheet.

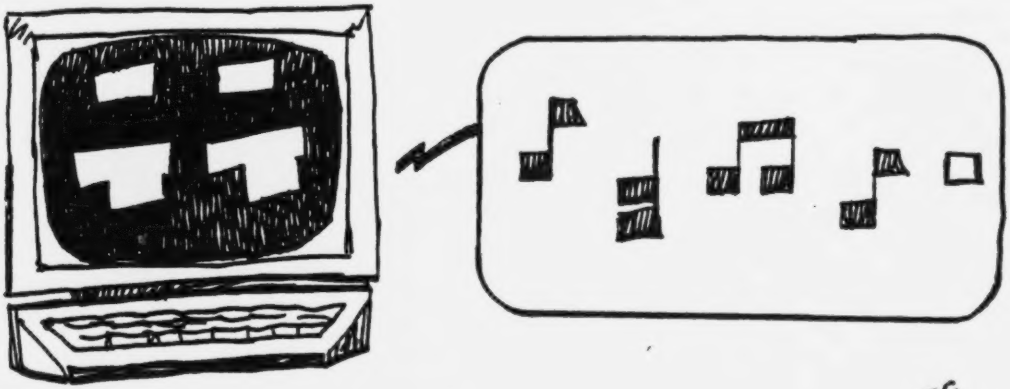
There are some very good programs out there in the forms of tutorials, drill and practice, simulations, and even some that will improve the students' thinking skills. You just have to find them.

The only way to tell how good a program is is to preview it. Even try it out with a student or two to get their reactions as to the clarity of the directions and whether the program holds their interest. Also, be on guard for programs where it is more fun to get the wrong answer.

Being able to preview a program without prepaying for it poses no problem. On the order form, state that you wish to preview the program for 15 days and that you will not copy the program. This is a very big DON'T. Authors work very hard on their material and deserve to have their efforts protected. Very few companies will refuse to send a program or part of a program to be previewed. If you return a program, a few notes as to why the program did not fit your needs would be useful to the company.

Having selected appropriate software, you are now ready to introduce the computer to your class. You will find your thorough preparation will insure successful integration of the computer into your lesson plans and maximum benefits for your students. Some students will already be acquainted with computers. All your students will be anxious to use the computer. With this enthusiasm the computer becomes a very important learning tool.

Computers seem to be the way of the future. As an educator, it is your responsibility to learn to use them effectively in preparing your students for that future.



SG

MY NEW FRIEND...MR. APPLE

Linda D. McCrone

Computers aren't anything to be afraid of. Really! Take it from someone who has been that route and who has "seen the light" if I may say! A computer in a classroom can be a friend if you let it be.

A year ago I was lucky enough to have been enrolled in a mathematics course in which a segment of the class was devoted to the microcomputer -- the Apple. At that time I was fascinated at all that "magical little thing" could do. I watched the instructor as he introduced this piece of machinery to the class. Sitting there, listening to the instructor, I became enchanted with the whole facet of microcomputers for classroom use. Could I actually learn to use a computer efficently?

The day finally arrived when it was my turn to work on the Apple. Scared? Scared indeed! In groups we were encouraged to "explore" the Apple. We learned how to "turn it on" and "turn it off", which, in fact, was my first major step entering into the world of computers and will most definitely be yours before you know it.

Since that time, I've been lucky enough to have been hired into the teaching profession. My job as an educator revolves around kids. My job involves helping kids, helping them to grow, to explore, to predict, to confirm and to learn. Helping kids to create a "desire" to want to learn is a necessity.

Computers in a classroom can be valuable to any teacher if used properly and not abused. Before implementing anything new into a curriculum one must question its purpose. Is this new idea really worth attempting? Does it go somewhere worth going for the child? Does this new idea allow and promote learning to take place? (The same questions should, of course, be asked of text books!)

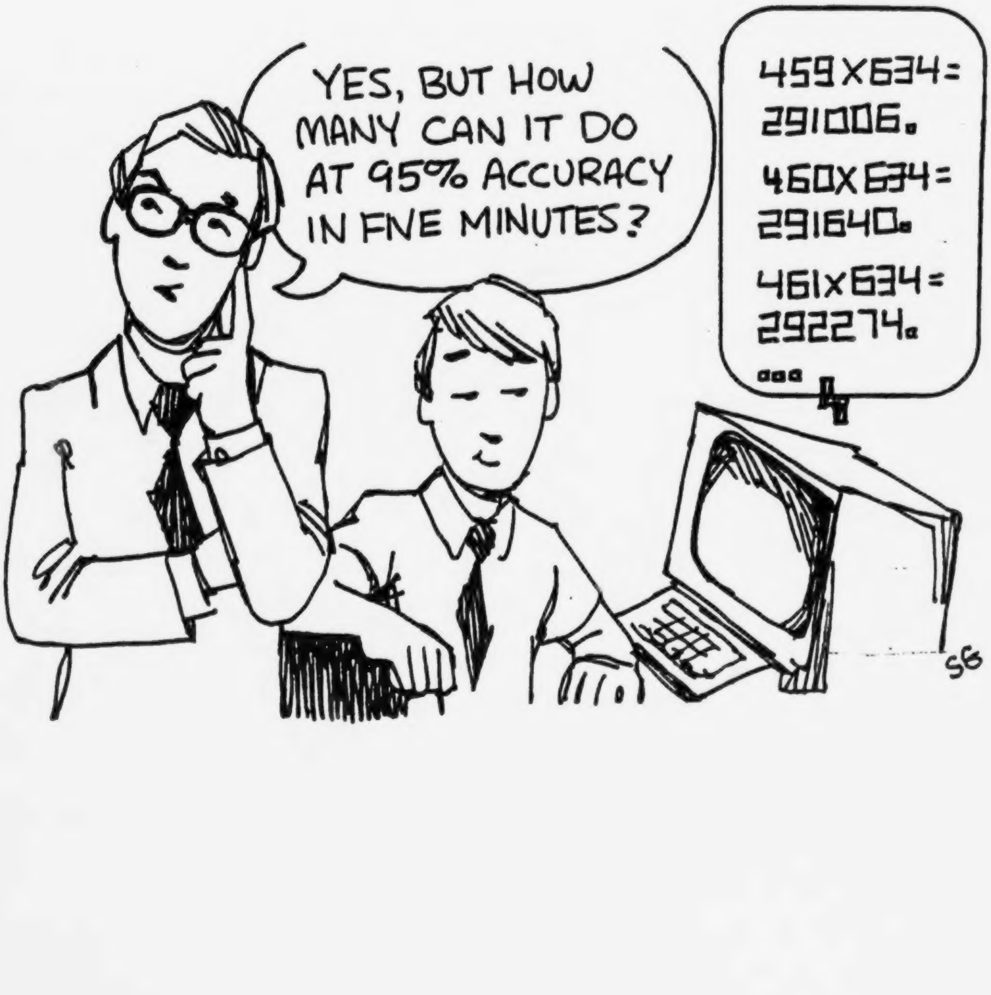
In regard to the microcomputer, the answers to all of these educational issues that so often times arise may be thought of in a positive sense. Microcomputers allow a child to "dig," to "explore" and encourages him/her to find out "just a little bit more " They can help children get "turned on" to learning. That's what I want for my students. How about you?

In today's rapidly developing technology, there is a real need for computer literacy. Today's children need to become familiar with computers; otherwise, they'll be illiterate in one true sense of the word.

Computer systems are "patient" teachers. They allow children to participate in private learning experiences. They may be used to help children learn things that normally aren't part of any curriculum. Computers allow for a hands-on approach to learning, an interactive technique to teaching. The computers help children to go beyond that which is normally done in the classroom. Computers allow one to approach teaching differently, in a more open ended, more creative way.

The whole world of computers awaits you with the "flip of the switch." Don't be afraid of trying something new! As teachers frequently advise students: "Don't be afraid to try, it's not hard if you only try...remember, you learn from your mistakes."

I strongly encourage you to get started immediately. Fear no more! Get acquainted now with your new friend, Mr. Apple. Explore! Don't worry if it's fun and exciting. Nowhere is it written that learning has to be dull!


YES, BUT HOW MANY CAN IT DO AT 95% ACCURACY IN FIVE MINUTES?
459X634= 291006.
460X634= 291640.
461X634= 292274.
...
SG

WHERE DO WE START?

Shirley Barthel

I imagine most elementary schools by now have at least one computer. Unfortunately, I can also imagine teachers and principals thinking, "WE GOT IT! Now what?" No one said it was going to be easy. From my experience, most elementary teachers do not know how to use a computer, let alone how a computer can be used as an effective tool in classroom instruction.

I remember asking some of the teachers if they were interested in attending a course on computers in education. One first grade teacher I know said she knew all she needed to know, since the teachers were given some instruction on an institute day. But I really don't think she realized the impact computer instruction could have on her children and the necessity of being introduced at an early age to such growing technology that is definitely here to stay. In the near future there will be a growing need for children in the primary grades to become acquainted with the keyboard, other technical equipment, and even typing!

So the first step, logically, would have to be to educate the educators! And, also, since a lot is learned at home we can not leave out educating the parents besides. What a task!

I suppose I have been lucky, since I was introduced to a CRT back in 1974 at McDonnell Douglas Corporation. Of course, the experience was somewhat different than using the microcomputers of today. But perhaps that's why I am interested and relatively unafraid to jump in. It is such a fascinating field, but most important for the sake of my children I want to keep up on what's happening and what will be a necessity in the future. I'm sure most good educators and parents feel the same way.

The second step would have to be finding good software. Most commercial software can get expensive so it's best to shop around and only pick the cream of the crop. There are programs which are free (available for copying charges only) and are open to the public. For example, CUE (Computer Using Educators), MACE (Michigan Atari Computer Enthusiasts), and Willy and Jacqueline Von Hamme have produced such programs, many of which are excellent and would be a good start. There are also many computer programming books and magazines on the market that have already established programs you can punch out yourself on a new disk/cassette.

Some of the qualities you might be looking for in your programs are educational quality, motivating graphics, accurate content, eye-hand coordination usage, good classroom review (Will the children like it? How will they react?), support material (Does the program give extra material?), technical review (Is the program sound or are there kinks?), satisfactory goals (Does it achieve what you want?), implementation (Is it easy to use?), understandable directions, and teacher options (Can the teacher control certain aspects to enhance the children's learning?).

After you have some software to work with you will want to start cataloging the programs. For example, you could number each disk/cassette, place the numbers on loose leaf paper in a ring binder or on index cards to by kept in a file box, record each program found on a particular disk/cassette along with a description of the program and the approximate age or grade level which is most appropriate for that particular program. Needless to say, his could definitely get very time consuming, but would pay off in the end. And if you want to use the material efficiently and effectively it is a must!

Next in line would be implementing the wealth you have. In other words, setting up a schedule. This could be THE major problem! Everything needs to work out harmoniously and there's so much to consider: for example, how many students are involved, how many computers are accessible, what other scheduled activities (music, art, P.E.) are involved, and if departmentalized, what subject areas would computer usage best fit into (after all there are programs on the market for every subject area)? One special time could be set aside for computer lab and the content could be varied. It has even been suggested that videogames should be included since it can help improve a child's eye-hand coordination. Another thought, and one which makes the most sense to me, is to have a computer lab sign-up sheet, like most schools have for the use of their projectors, filmstrips, etc., making sure each class gets its fair share of the computer experience. Younger children would probably start out with 20 minute sessions once or twice a week, the time allotted gradually increasing as the children get older, and at the top, upper grade children would use at least a half an hour every day on the average.

Perhaps even before going into the computer lab a teacher should schedule some pre-lab experiences such as a discussion about computers. Maybe some pupils have parents who work with computers. Maybe some pupils have a computer at home. Let the students bring out as much information as possible and relate their own experiences. It will give you some insight on how much they know and who needs the help most. Another suggestion is to have a drawing of the type of keyboard they will be using. Make dittos so each child has his own keyboard and practice things you are going to do once you get into the computer lab. Important also are things not to do (The Don'ts); such as, touching the oval slot on the disk which would erase what's stored on the disk. These things have to be discussed.

Don't be disturbed if you do not have enough computers for each child. Group instruction can work out extremely well. Like most elementary schools today, the Southern Illinois University at Edwardsville computer workshop was also limited as to the number of computers available to use. Because of this we conducted most of our viewing in small groups. Each person within the group got a chance at the keyboard. It worked out great. Since we didn't know the programs, we helped each other and learned from each other as we evaluated the various programs. Working in groups can be an invaluable learning experience. Even if a student gets to have little "hands on" computer experience, at least he's had some, and most important he's had the opportunity to think and to see the computer in use. After a student has gotten familiar with the computer, then he can explore on his own, if scheduling permits. The non-threatening computer can also be used to help in individualized instruction. It provides immediate, positive feedback and its patience in waiting for a child's response is unmatched by any human.

However, it is felt that the computer should not be used individually to the point where it replaces social interaction.

Post-lab discussions are important and should follow every lab session. That gives students time to reflect, to ask questions, and to evaluate their own work. Stimulating conversations, I'm sure, will occur. Team scores should be taken where applicable.

I hope I have given you a few ideas as to where and how to start developing and implementing computer experiences for your students. Chances are good that they will take to this new adventure quicker and easier than their teachers!

Address References

Classroom Computer Learning
Pitman Learning Company
19 Davis Drive
Belmont, CA 94002

CUE Softswap
San Mateo County Office of Education
333 Main Street
Redwood City, CA 94063

MACE Kids
P. O. Box 2785
Southfield, MI 48037
(software for preschool and young children)

Willy and Jacqueline Von Hamme
Rue Firmin Martin, 2
1160 Brussels, Belgium

SOFTWARE
REVIEWS

Program Title: A IS FOR APPLE

Disc Title: "Getting Ready To Read And Add"

Source: Sunburst Communications

Recommended Grade Level: Preschool-2

Reviewer: Linda McCrone

The game is designed to help children with letter sounds. A picture is shown on the screen in the middle of a box. In each corner of the box is written a letter. The object of the game is for the student to select the letter that makes the sound that the picture begins with. The player is given two tries to select the right letter. If the student is unable to select the right letter, a circle is drawn around the correct letter.

The theory behind this program is fine, but it has a major flaw. The objects drawn in the box may be difficult for children to identify.

Sunburst provides the purchaser with a complete instruction booklet and teacher's guide. The program has a teacher option for selecting letters to be used in the program.

Program Title: ALIEN INTRUDERS
Disc Title: "Challenge Math"
Source: Sunburst Communications
Recommended Grade Level: 1 - 6
Reviewer: Evlyn McQuinn

In this program an alien intruder is attacking a spaceship. The student is to defend the spaceship by finding the correct solution to math problems (addition, subtraction, multiplication, division, of whole numbers or decimals).

This program utilizes the computer's ability to generate problems randomly. It was designed to give students practice in basic arithmetic operations. There are teacher's options that allow the teacher to preset the type of problems, the operation, the number of problems, the speed settings, and whether to use sound or not.

The instructions are given visually and require only minimal reading such as "move left" and "press return".

The support material contains a student record sheet that can be prepared for students. On the record sheet students can record their scores for up to five games.

This program only provides drill and practice. (It was designed to be an action game requiring quick recall of basic number facts.)

Some may interpret the alien's attack on the spaceship as unnecessary violence. The alien "gets" a wing of the spaceship if it attacks the correct answer before the player defends it.

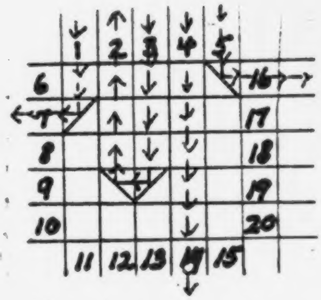
Program Title: BAFFLES

Disc Title: "Baffles"

Source: Conduit

Recommended Grade Level: High School

Reviewer: Mary Steffen



"Baffles" is a game that uses a grid into which hidden baffles are placed at 45 degree angles.

When laser probes are fired down any of the grid lanes hitting a Baffle, the probe is deflected right or left depending on the baffle's orientation.

Lanes having no hidden baffles provide no deflection and probes follow that lane to the opposite side. Complications arise when a probe hits 2 or more baffles on one trip. By firing laser probes, the player must determine the location and orientation of the hidden baffles.

Hypothesis testing is immediately emphasized. Data collecting and record keeping skills are sharpened. Since multiple baffles may make what seem simple and obvious more complicated, students soon learn to withhold judgment until logical necessity proves what must be the case.

For older elementary students, playing the game is challenging and engaging. Some difficulty is encountered initially in converting what the student wants into language the computer can handle. With a little teacher help these early problems are easily overcome, and worth the effort.

Program Title: BAGELS

Disc Title: "Figure Fun: Number Games and Drills"

Source: Sunburst Communications, Inc.

Recommended Grade Level: 3 - 6

Reviewer: Connie Funkhouser

"Bagels" is a number game in which the computer thinks of a two, three, or four digit number. It is the student's job to guess that number. He first determines how many digits the number should have. Then he takes a guess. Should the guess be incorrect, and it no doubt will be, the computer gives a clue. Next to the student's guess will appear one of the following words:

Bagels - means none of the digits are correct.

Pico - means one digit is correct but in the wrong place.

Fermi - means one digit is correct and in the right place.

Until these terms can be memorized the student will need to keep a copy of the definitions in front of him. He continues guessing and these clues are given until he guesses correctly. Should he give up before he comes up with the correct answer, he may type zeros and he will be shown the answer. Naturally two digit numbers are easier than three and four digit numbers.

This game is based on the ideas of a non-computer game called Master Mind, although Master Mind is played with colors and not numbers.

The manual comes with some good ideas for individual participation and group competition. To facilitate guessing, use the provided worksheets for recording the results.

Fancy graphics are not an important facet of this game.

Program Title: BEWARE OF THE BILIRATES AND THE SYLAMANDERS
Disc Title: "Chambers of Vocab"
Source: Reader's Digest Services, Inc.
Recommended Grade Level: 4 - up
Reviewer: Stephanie Garcia

This is a vocabulary game. There are directions, but I did not feel that they were too clear. There are different levels of difficulty.

There are warm-up activities that allow you to study the words before you use them.

I found the game to be awkward and uninteresting. It is truly a game of speed. A student must possess typing skill, or the program can never be done properly.

I did not particularly care for the graphics. And as far as I can see, it is simply another way of drilling vocabulary words. The words appear totally out of context.

I will certainly not recommend this program for any school at any time.

Program Title: BUBBLE DOTS

Disc Title: "Bumble Games"

Source: The Learning Company

Recommended Grade Level: 4

Reviewer: Connie Funkhouser

Using coordinates on a graph, a student has a choice of copying a computer drawing or making a drawing of his own. If he chooses to copy the computer drawing he has a choice of making a whale, clown, house, boat, or a kite. Bumble will show him a dot on the graph. He must name a pair of coordinates and keep naming other pairs until the shape or drawing is complete. If he makes a mistake Bumble will show him how to correct it.

If he chooses to make his own drawing, he first has a choice of how many dots to use with the option of changing his mind later. Bumble gives him a chance to name his picture when he is finished. At that time Bumble will ask if a friend would like to copy his drawing.

Technically, this game is very attractive. There are constant changes taking place as the drawing is made. The student remains in control and help is given when mistakes are made.

Originating a drawing seems a bit more creative than copying one. Practice in locating points on a graph is an objective of both games, and both achieve that objective well. This game could be played as a follow-up to initial graph instuction, or children could learn about graphing by playing it. Children could do something similar on graph paper, but the computer better facilitates the concept and objectives.

Even though this game is stimulating, I think students might tire of it after a given amount of time, particularly if they master it quickly.

Program Title: CATERPILLAR
Disc Title: "Getting Ready To Read And Add"
Source: Sunburst Communications, Inc.
Recommended Grade Level: Preschool - 1
Reviewer: Betty Howard

Caterpillar reinforces the memorization of the upper case alphabet letters in sequence. A group of five sequential alphabet letters randomly chosen is displayed on the screen with one letter missing. The student types in the missing letter. A colorful caterpillar appears on the screen a section at a time for each correct response the student makes.

The directions are precise. The type is large and clear. It's colorful and attractive. It is a drill and practice exercise.

Program Title: CHANGE ME

Disc Title: "Moptown"

Source: The Learning Company

Recommended Grade Level: Intermediate

Reviewer: Audrey Hartzheim

This challenging and fun program is located on a disk entitled Moptown along with ten other programs. Moppets are the characters in these programs. All Moppets possess four traits. They can be either short or tall, fat or thin, red or blue, or be either a bibbit with big feet and big noses or a gribbit with a tail.

Four boxes appear on the screen. A different Moppet appears in the first and last box with two empty boxes in the center. If Rule 1 flashes on the screen, one trait must be changed between each box. If Rule 2 flashes, two traits must be changed each time. The two choices for each trait appear on the screen and the student enters his selection. If completed properly, "You Win" flashes on the screen.

The student is asked if he wants directions. This is a favorable aspect because some students might enjoy experimenting to discover the rules on their own and if the student is familiar with the program he can continue immediately. The directions were clear and examples were given to illustrate the rules. Instructions were also given for how to exit or return to directions. The manual had good descriptions and necessary accompanying instructions and also listed additional ideas and activities. This program is reliant on color but instructions were given to use it with black and white.

There is no time limit for responses. If the rule is not followed the student is informed and requested to try again. If an incorrect key is pressed no entry is made. Another good point is that it lists the chosen traits so the student can readily review information he's been given.

Change Me is a good program for intermediate grades. It utilizes logic and thinking skills. The student must look at similiarities and differences. Attractive displays make it fun and interesting and it is not overly time consuming.

One advantageous change would be to allow the student the option to select the rule or to have the computer select it at random.

Program Title: CLUB HOUSE

Disc Title: "Moptown"

Source: The Learning Company

Recommended Grade Level: Ages 4 - Adult

Reviewer: Connie Funkhouser

Club House is only one of eleven challenging games found in Moptown. Each game progresses from the very simple to the very difficult. Club House is number 9 on the menu. Each of the eleven games utilizes the same characters called Moppets. Each Moppet has four characteristics: tall or short, fat or thin, red or blue, bibbit (big nose and big feet) or gribbit (tail). This makes it possible with various combinations to have sixteen different Moppets.

In the game Club House only Moppets with certain characteristics are allowed to join the secret club. The object of the game is to guess the rule to join the club house. The student begins by randomly selecting a Moppet from the sixteen choices at the top of the monitor. If the Moppet qualifies for membership, he is put into the club house. If not, an X appears on him. The student keeps trying various combinations until he thinks he can guess the rule. (For instance: redness, tallness, thinness, etc.)

What about the educational quality of this game? Superior! No other method can possibly facilitate the problem solving aspects of this game concept as well as the microcomputer.

This particular game utilizes high intensity graphics which are most pleasing. But more important than the attractive layout is the challenge the game provides. Students will have to think.

The accompanying manual has good, clear-cut directions for playing all eleven games. However, objectives are not defined, nor does it provide suggestions for using it in the classroom. Directions on the program are simple but lengthy.

Note: The game can be used on a black and white set. The red and blue are distinguishable by shading.

Program Title: CONCENTRATION

Disc Title: "Memory: The First Step In Problem Solving"

Source: Sunburst Communications, Inc.

Recommended Grade Level: 1 - 6

Reviewer: Linda McCrone

Concentration is a matching game. The object of the game is to match the most pairs of items in the fewest tries. This game requires strong memory skills. Strategies must be developed for playing the game successfully.

This program can be an effective learning tool. Concentration is a game designed to help kids develop their problem solving and memory skills. The game allows for a child to play individually or with another player.

The Concentration Game comes with an instructional manual. Lesson plans and record sheets are supplied. This program allows for a 30 day classroom preview, and a free lifetime replacement guarantee.

The technical quality of "Concentration" is excellent! Graphics and type size are clear and easily readable. Children are instructed when to take their turns and are given adequate time to complete their moves! The program provides supportive feedback and at appropriate times.

I have had the opportunity to observe children playing this game. They find it challenging and fun to play. They are anxious to share their strategies for completing the puzzle with each other. The authors planned the game to be a competition, but the children prefer to collaborate -- to work together to develop and refine their strategies.

Program Title: DECIMAL PATTERNS

Disc Title: "Fractions"

Source: Opportunities for Learning, Inc.

Recommended Grade Level: 7 - Adult

Reviewer: Carol Beste

"Decimal Patterns" is an enrichment program for students after they have worked with finding the decimal equivalents of fractions.

The program is a game in which students are to decide if the decimal equivalent for a fraction terminates, repeats from the decimal point or has a non-repeating portion and then a repeating period. The game will lead students on a search for patterns to predict the behavior of decimal equivalents.

The program directions are clear and the program leads students through a fractional equivalent with step by step questions. If a student answers a question incorrectly, he is immediately told why it is wrong.

The support material is good, explaining program concepts and usage.

Program Title: DIGITOSAURUS

Disc Title: "Challenge Math"

Source: Sunburst Communications, Inc.

Recommended Grade Level: 2 - 6

Reviewer: Evlyn McQuinn

This program uses a game format to give the student practice in performing basic math operations with whole numbers and to give the student practice in estimating by choosing which of three problems will give the largest answer.

Teacher options are available to select the math operation, difficulty level, and to erase the student scores. The supplementary material lists the type of problems given at each different level.

Scoring is an important aspect of the game. The objective is to get Digitosaurus older and wiser. The student has ten chances to help Digitosaurus grow older. More points are given for the largest correct answer on the student's first try. At the end of ten tries, the student may enter the "Hall of Fame", which holds up to ten names. There are four Hall of Fames, one for each math operation. The name of the student, the name selected for Digitosaurus and the score is recorded.

The main weakness of Digitosaurus is that once the student has selected what he/she believes to be the problem with the highest answer, he/she cannot change his/her selection.

Program Title: ECO SIMULATION

Disc Title: CUE Softswap #4

Source: CUE Softswap

Recommended Grade Level: Jr. High - High School

Reviewer: Jill Frey

The program allows the player to become better accquainted with how an ecological food chain works. The player should have some previous knowledge about food chains.

The purpose of the program is to determine what number combination of animals, birds, insects and rodents may live in balance on a three acre grass plain for the greatest number of years. This information is then converted into a numerical score. An individual or a group thus tries to attain the highest score.

The player is given basic information about the population of cattle, songbirds, and hawks on the plains. One is then asked to indicate how many cattle, songbirds and hawks one wants. The computer predetermines the number of rodents and grasshoppers. The simulation is then enacted and the number of each inhabitant is flashed on the screen along with the length of time that has elapsed. When the eco-system becomes unbalanced due to one inhabitant population becoming too large, the computer indicates which one has caused the system to break down. A score is then presented.

The program does not have written objectives, supplementary materials or a score sheet. The objectives and supplementary materials are not necessary; however, a form used to transcribe the information and score from the computer would be helpful to the student. This information may be used the next time the program is played so that one can use the previous knowledge in helping to determine what new stratagies one will use.

Using the simulation program the students themselves must determine what information is essential, how to organize the information, develope hypotheses, test them and finally find the solution or solutions.

Program Title: EXPLORER METROS

Disc Title: "Explorer Metros"

Source: Sunburst Communications, Inc.

Recommended Grade Level: 4 - Adult

Reviewer: Carol Beste

"Explorer Metros" is an exercise in familiarizing students with the concepts of metric units.

Students must explore an alien planet in a given amount of time. To complete their exploration they must make estimations about metric units of mass, length, temperature and capacity in a given situation; such as, do they wear a coat to cross a section of land where the temperature is 33°C. If the students need help, they may ask to see the metric conversion chart or ask the help of a robot named Dugan. But he doesn't always tell the truth and costs them valuable time. When time runs out they are beamed back to their spaceship without learning everything about the planet.

This program has colorful graphics and will keep students interested.

The fascinating feature for teachers is that you can edit this program yourself. The support material has complete instructions for changing the problems and even for changing the pictures accompanying the problems.

It is a very interesting way to learn metrics.

Program Title: FURS

Disc Title: "What Would You Do? Simulations in Social Studies"

Source: Minnesota Educational Computing Consortium

Recommended Grade Level:

Reviewer: Dennis Works

This is a simulation experience in which students play the leader of a French fur trading expedition in the 1770's in the Lake Ontario area. Playing the game requires making decisions as to where to trade furs and what type of furs to trade. The program starts each player off with $600 and the goal is to increase the original investment. The game is relatively simple to play. A player chooses a total of 190 furs of either mink, beaver, ermine, fox, or any mixture of these and then decides which of three forts he will take his furs to. The easier fort will pay lower prices, but it has fewer hazards to overcome. After the choice of furs and forts is made, the computer shows the cash value received for the furs and the total profit. The program can be used individually or by an entire class.

Program Title: GERTRUDE'S SECRETS
Disc Title: "Gertrude's Secrets"
Source: The Learning Company
Recommended Grade Level: Ages 4 - 9
Reviewer: Virginia Small

This game states it is for children 4-9 years of age. A considerable amount of print appears on the screen before the game starts so the young child needs someone who can read the rules to him/her.

Gertrude is a goose. The player is told how to pick her up and take her to the puzzle room. If he wants directions for how to play the game he goes through the door marked "How to Play" to see a sample of the puzzle room. After he has watched the sample, he is returned to the puzzle room and told to let Gertrude go. Gertrude flies off the screen and returns with colored shapes to put in the grid according to the rules. To play the game the child picks up a shape from the top of the screen and places it in one of the squares of a 3 x 3 grid. If this is the correct place for the shape it stays in the square. If a shape is put in the wrong square, it slips out of the square down to the bottom of the screen. This gives a clue that another shape or color must be chosen. The child isn't told that the piece chosen is wrong but infers it should be placed elsewhere. There is no time limit so the child is able to work at his or her own speed. When the puzzle is solved Gertrude will return with a prize from the treasure room. If six prizes are won, the player becomes a Secret Master.

This is a super program for children. They need to plan ahead, by thinking logically with a kind of order to place the shapes in the desired patterns. The game could be demonstrated in the classroom with attribute blocks.

As I played the game I had the feelings of frustration that a child learning the game would have. I let go of Gertrude before we got to the puzzle room and then had quite a time trying to find her again. When Gertrude was found (by trial and error) I had a wonderful feeling of success. It was like being in the child's shoes as he learns something new.

Program Title: JOTTO

Disc Title: CUE Softswap #7

Source: CUE Softswap

Recommended Grade Level: Intermediate - Adult

Reviewer: Audrey Hartzheim

Jotto is an excellent language activity as well as an exercise in problem solving and analyzing.

The player has twenty guessess to discover the computer's hidden five letter word (the hidden word has no two letters alike). The player enters a five letter word and is told how many of the same letters occur in the hidden word. If a wrong entry is made such as a word with two letters the same or a word with more or less than five letters, the player is informed but that entry is not counted as an attempt.

Also provided is an alphabet in the upper right corner from which the player can delete letters that he is certain are not in the word. At the bottom right it is possible to enter letters which he thinks are in the word. This scratchpad is an asset. However, one drawback is that letters cannot be erased if guesses are incorrect. After each guess the player is asked if he wants to add or delete letters from these lists.

The directions were adequate and examples were provided. The instructions also stated which keys could be pressed for yes and no and told the student how to exit the program. The program seemed to be of good technical quality.

Although this type of game could be played without a computer it would be lengthy, would require teacher time and probably would not be done on an individual basis. There are no elaborate graphics or displays, it is in black and white, and there are no support materials, but it is interesting and challenging. It requires the student to scan, gather information and analyze to find the solution. It is a good program, one which students would enjoy and profit from. It is public domain material.

Program Title: JUGGLER'S RAINBOW
Disc Title: "Juggler's Rainbow"
Source: The Learning Company
Recommended Grade Level: Ages 3 - 6
Reviewer: Virginia Small

Along with the disk come blue strips of tape to stick on the typewriter to form 4 sections on the keyboard. The directions state "Press any key you want and watch what happens. If you press the keys too quickly nothing happens. If a blinking square appears in the corner it is ok to press a key." After the rainbow is formed, the bottom section represents rain and the top of the colors represent the rainbow. After the rainbow and the rain have been formed, when keys are pressed different sequences of colors appear in the rainbow and rain. Optional sound is available.

This is a game for the young child. He/she discovers how to make the rainbow and the rain by trial and error. This is a good game for introducing children to computers. The children would enjoy the colors. I would use this with my first graders. This is a game that could not be reproduced in the classroom. It would be an enrichment to the school program that would need little supervision.

Program Title: MAD CHEMIST

Disc Title: CUE Softswap #4

Source: CUE Softswap

Recommended Grade Level: 6 - 8

Reviewer: Jill Frey

"Mad Chemist" is a program designed to give practice in determining the correct mathematical proportions of two chemicals needed to produce a specific product. Students should have some knowledge about proportions.

The student who becomes a scientist working with deadly chemicals, is given the proportions to which the two chemicals must be mixed. The computer indicates the first chemical's quantity and the scientist must determine the second chemical's quantity using the correct proportion. When the answer is correct the two chemicals are mixed in the flask on the screen and a written reward is flashed. If the answer is incorrect, the chemicals blow up when mixed and the scientist is killed. To proceed to the next problem the student is asked if they want to be reincarnated.

The student is not given a second chance to determine the correct answer, neither is the correct answer flashed on the screen. The program does not provide written objectives or teacher support materials. The program is a drill and practice activity for an individual. The problems do not change nor does the difficulty level, so after a student has used the program a few times it is of no further use to him. A teacher option built into the program would be an asset.

Program Title: MATH DICE

Disc Title: CUE Softswap # 4

Source: CUE Softswap

Recommended Grade Level: 4 - 8

Reviewer: Audrey Hartzheim

Five dice are rolled and displayed on the screen. The player is told to select one die for keeping. The remaining four dice are rolled and then he must choose another number and a function, +, -, x, ÷. Each function may be used only once. The student continues until the final two dice are left and the score is computed. The object is to score as many points as possible. The highest possible score is 71. A running score is recorded on the screen as well as the student's previous high score if he has played more than one game.

Directions were adequate but could have been more explicit. The program is in black and white and there are no elaborate graphics, just simple displays. However, the game is challenging and thought provoking and is motivating in that respect. There is no time limit so the student can analyze the situation and plan his moves. No technical faults were found with the program.

"Math Dice" can be recommended because it requires higher level thinking. The student must not only decide the best choice of dice and the function but he must plan ahead for the next possible move. Since there is no right or wrong answer, the student is free to experiment and take guesses. It combines using cognitive strategies with arithmetic skills which is beneficial and worthwhile.

Program Title: MATH MANSION

Disc Title: "Challenge Math"

Source: Sunburst Communications, Inc.

Recommended Grade Level: 3 - 8

Reviewer: Audrey Hartzheim

"Math Mansion" is an appealing, motivating program designed for grades 3 - 8. It involves answering math problems correctly to collect aids and to move from room to room to escape the haunted mansion.

A colorful graphic appears on the screen along with a problem. The student must enter a function symbol and a number to finish an incomplete equation. For example, 15 - - = 30. Two possibilities could be 15 x 2 = 30 or 15 + 15 = 30. If the problem is answered correctly the student progresses to the next room. If incorrectly answered, the problem the child entered appears on the screen and another problem is given. In some rooms the student must choose which room he wants to enter next or decide to pick up an aid to escape from other rooms in the future.

The directions were adequate and gave specific examples. However, it would be helpful if students were instructed which keys can be used to enter the functions or told that yes or no can be entered with a Y and N.

The program is educationally sound. It requires higher level thinking since more than one answer can be given. It is more than simple drill and practice -- the student is expanding his arithmetic skills. Another plus is that there is no time limit so the child can progress at his own speed. The student must also form a logical pattern of the rooms in his head, remembering the rooms he has encountered and those he still needs to enter. A diagram of the floor plan is included or students can devise their own by drawing conclusions and establishing relationships between the rooms.

The manual accompanying the program is quite complete and informative. Objectives are listed and suggestions for classroom uses are given. There are no teacher options with this program but the problems are selected at random by the computer and there are at least two answers for each problem so this allows for variety and to a degree enables students to regulate the difficulty. This is a better than average program.

Program Title: NOMAD

Disc Title: "What Would You Do? Simulations in Social Studies"

Source: Sunburst Communications, Inc.

Recommended Grade Level: 4 - 6

Reviewer: Dennis Works

This simulation game involves some map reading skills. (Students must have previous knowledge of directions.)

The player receives a letter from Grandma requesting a visit. After a short plane ride, the player is given a display of a city with all roads labeled and is told where Grandma's house is located. From the starting point, the player must decide when to go left, right, or forward and then must choose at what speed to travel. If the player chooses an excessive speed he will be ticketed or may even be in an accident. The goal is to reach Grandma's in the shortest amount of time. Four worksheets on map work accompany the disc.

Program Title: OREGON TRAIL

Disc Title: "What Would You Do? Simulations in Social Studies"

Source: Sunburst Communications, Inc.

Recommended Grade Level: 3 - 6

Reviewer: Edward Graves

This program simulates a trip over the Oregon Trail from Independence, Missouri to Oregon City, Oregon in 1847. The distance is 2040 miles and will take 5 - 6 months.

You have saved $900 to spend for the trip, and you've just paid $200 for a wagon. You will need to spend the rest of your money on the following items: oxen, food, ammunition, clothing, and miscellaneous supplies.

You can spend all your money before you start your trip or you can save some of your cash to spend at forts along the way when you run low on supplies. However, items cost more at the forts. You can also hunt along the way to get more food. Whenever you have to use your trusty rifle along the way, you will be told to type in a word that sound like a gunshot. The faster you type in the word, the better chance you will have of hitting your target.

This program is fun to play. It also provides experience in managing money and goods. The program gives the student a feeling of the hardships and danger the early settlers had to face on their journeys.

The program could be used as a class problem solving task beginning in the second grade.

Program Title: PETS, PITS, PATS, POTS

Disc Title: "CUE Softswap Disk 2"

Source: CUE Softswap

Recommended Grade Level: 4 - 6

Reviewer: Carol Ann Seibel

Pets, Pits, Pats, Pots is a program to encourage use of dictionary skills. It gives meanings for words, the number of letters in each word and the beginning syllable in each word. The player is then asked to guess what the word is. When a word is not correctly guessed after two tries, the right word is given. This provided help when the player got in a tight spot and needed help. Scores are given at the end of each game.

Program Title: PICTURES

Disc Title: "Getting Ready To Read And Add"

Source: Sunburst Communications, Inc.

Recommended Grade Level: Preschool - 2

Reviewer: D. Yunker

This program uses a "Concentration" game format with an assortment of pictures or words in twenty boxes. It reinforces memory of pictures or words and their locations, along with providing an opportunity for developing problem-solving skills.

The game can be played with all pictures or all words. The shapes are easier to recall - recalling words is more difficult. The recommended grade level is preschool - 2nd grade; however, I think that children in grades 3 - 6 would enjoy it too. The graphics are really nice and it is a fun and challenging game to play.

Program Title: SECRET PAL

Disc Title: "Moptown"

Source: The Learning Company

Recommended Grade Level: Elementary - Jr. High

Reviewer: Jill Frey

Secret Pal is one of a series of programs about attributes. The programs on the disk progressively increase in difficulty with the first two being appropriate for lower elementary and the last ones appropriate for Junior High.

Secret pals are moppets who live in Moptown. They are made up of four physical characteristics out of a possible eight. The characteristics used are tall-short, fat-thin, red-blue, and Bibbits (big feet and big nose) and Gribbits (tails).

The purpose of the program is to have the player determine all four characteristics of a secret moppet in the least number of tries. The computer gives an example and then draws the moppet the player describes. It will make one yellow mark under the moppet for each correct attribute. The player is allowed ten tries to determine the four characteristics. If on the tenth try the player does not have all four characteristics the secret pal is put on the screen. When the player is correct the moppet is surrounded by a flashing box augmented by music.

The program is designed to encourage the player to develop or improve problem solving strategies and to formulate and test hypotheses.

The program comes with a manual which gives objectives and explicit directions. Alternative games, activities and suggestions on how to use the program with a classroom of students is also provided.

Program Title: SIMON SAYS

Disc Title: "Memory: The First Step In Problem Solving"

Source: Sunburst Communications, Inc.

Recommended Grade Level: K - 2

Reviewer: Virginia Small

"Simon Says" is a good introduction to the world of computers for young children. It is a game of sequential memory. A series of colors, numbers or letters appear on the screen, and the child is asked to reproduce it. As long as the player gets correct sequences, more sequences are generated by the computer. If an incorrect sequence is given, the child is asked if he wants to see the correct sequence. If he chooses to see the correct sequence, his score is given and he is then asked if he wants to continue with that game or choose another game.

The games can be played by one or more children and little adult help is needed.

I would use this game with my first graders.

Program Title:: SMART SHOPPER
Disc Title: "Survival Math"
Source: Sunburst Communications, Inc.
Recommended Grade Level: High School - Adult
Reviewer: J. Eckert

This was an excellent exercise for consumer education or high school home economics students. It would be challenging for most housewives! Prior knowledge of basic units of measurement and equivalents was needed. The shopper was given a time limit in which to choose the best buy in each aisle. By comparison shopping using various criteria such as the lowest unit price, the most reduced price or the lowest total price, the shopper must choose the item which was a better bargain. It required fast thinking, estimating and judgment and use of all four computational operations.

Other programs on the disk included "Hot Dog Stand" and "Foreman's Assistant". These programs are excellent for Cooperative Education students since they emphasize real-life skills. These programs are educationally sound--they "go somewhere".

Program Title: SPACESHIPS
Disc Title: "Getting Ready To Read And Add"
Source: Minnesota Educational Computing Consortium
Recommended Grade Level: 1 - 2
Reviewer: Audrey Hartzheim

Spaceship is a black and white program found on Elementary Volume Seven from the Minnesota Educational Computing Consortium. It is basically a math drill for first or beginning second grade. Addition facts up through nine were covered.

Spaceship does go beyond the typical drill program in some respects. The problem appears vertically and then objects appear in a row beside each addend. This is a good visual aid for young students. Another good point is that the problem also is presented in a horizontal position.

After entering one correct answer the spaceship appears, after two correct answers the interior of the spaceship comes into view and after the third correct response the spaceship shoots at another figure and disappears. This feature may be motivational for a period of time but after continued use might be rather boring. If the student gave an incorrect response, he was permitted to try again. After three incorrect answers, the correct response flashed on the screen and the game continued.

There needs to be explicit directions to instruct the child as to what is expected and how to accomplish the task. Although technically sound, there is little educational value beyond drill and practice which could be accomplished in the classroom by other means.

Program Title: SUMER

Disc Title: Elementary Volume 2

Source: Minnesota Educational Computing Consortium

Recommended Grade Level:

Reviewer: Dennis Works

This simulation has the player portraying the ruler of an ancient kingdom over a ten year period. He is faced with problems of land use, food production, pests, and starvation. Each year the ruler must decide how much money to spend on land, seed, food; how much to plant; whether to buy or sell land and various other decisions. The program gives information such as each person needs 20 bushel of grain, each can plant 10 acres, and other information concerning yield and price of land. This program requires pencil and paper figuring and could not easily be done by intermediate grade children. Junior high students and gifted students would find the program challenging. The ultimate goals of the ruler are to keep the population growing, increase the surplus grain stores, and increase the land holdings.

Program Title: TAXMAN

Disc Title: "Figure Fun: Number Games and Drills"

Source: MECC

Recommended Grade Level: 5 - 6

Reviewer: Connie Funkhouser

Taxman is a fairly difficult game that teaches students to deal with prime numbers, factors, and composites. This game is recommended for fifth and sixth graders but it could be of interest to older people as well. The student has a choice as to how many consecutive numbers he wants. Then from that list the student selects a number. The Taxman gets all the factors of that number. The computer keeps a running total for the student and the Taxman. Once all the numbers with factors are taken the remainder are given to the Taxman. The object of the game is to have a higher total than Taxman.

Overall educational objectives are: 1. to discover the factor properties of composites and distinguish between primes and composites. 2. to develop different strategies to use with "Taxman". 3. to analyze the results of strategies and learn why some work and others fail.

Graphics in this game are not flashy, but the game concept is so challenging that the plain graphics go unnoticed. The game is certainly motivating and good math students will like it because it makes them think.

Program Title: TEASERS BY TOBBS

Disc Title: "Puzzles and Problem Solving"

Source: Sunburst Communications, Inc.

Recommended Grade Level: 3 - 12

Reviewer: Virginia Small

This game begins with your choice of the following: 1. Addition, 2. Multiplication, 3. Description, 4. End. I chose addition. The levels suggested for this program are grades 3 - 12. Some reading is necessary and math skills are essential to play the game. Sample problems are given with Tobbs showing the player what to do first. The directions further state whole numbers 0 - 99 may be used. There can be 1 - 4 players and you are told the keys to press for player control of the game. Levels of difficulty can by selected and upon ending scores are given.

This game involves problem solving. It uses basic skills in a creative way. The grid used is like this sample.

+	2	3
4	?	7
6	8	?

The player supplies the missing number. As the game becomes more difficult the player needs to scan the grid for clues or hints as to what the missing number should be. In some cases multiple solutions are possible as more numbers are missing.

This game leads to an enrichment of numbers and concepts. Children can do challenging problems they thought they couldn't do before. Problem Solving games not only blend with the curriculum but also go beyond it. These games can be played with one player or in groups. Cooperation among players can lead to learning in a fun and non-threatening way. I consider this quite important with so many new learning situations facing children today. Although the game is for grades 3 and up I have found this can be used with some first and second grade students.

Program Title: THE POND
Disc Title: The Pond
Source: Sunburst Communications, Inc.
Recommended Grade Level: Intermediate
Reviewer: Mary Steffen

Imagine an animated pond of lily pads and a small green frog who apparently doesn't like to get wet. The pond can be successfully crossed with no wet jumps off the dry lily pads when students recognize jumping patterns for the frog's journey.

First a series of practice ponds in levels of difficulty is offered. Here students learn to discover patterns using raw data collected while the frog willingly gets wet.

Later a game is played which encourages efficiency of pattern. A series of ponds must be jumped across with points given for the fewest number of moves.

The Pond encourages students to think logically using raw data and then to generalize toward efficiency. These are life skills which students seldom engage in classrooms.

Program Title: THE TRAIN

Disc Title: "Getting Ready To Read And Add"

Source: Minnesota Education Computing Consortium

Recommended Grade Level: Pre-school - 1

Reviewer: Portia Peterson

The Train is designed to reinforce memorization of lower case alphabet letters in sequence. A group of five consecutive letters of the alphabet is randomly chosen and displayed on the screen with one letter missing. The student types in the missing letter. After each correct response, a train, engine, cars and caboose appears.

The objectives of this drill are: to match printed lower case letters with their names; to determine the missing letter in the alphabet sequence; to match a letter name with corresponding key on the keyboard and to match the lower case and upper case symbols for a given letter.

Another game that might be considered for use prior to this one is the Caterpillar. This game drills on the capital letters of the alphabet.

Program Title: THE HOT DOG STAND

Disc Title: "Survival Math"

Source: Sunburst Communications, Inc.

Recommended Grade Level: 6 - Adult

Reviewer: Carol Beste

"The Hot Dog Stand" is a simulation which can be used by a single student or by two or more as a game.

The students are to set up a hot dog stand at the school's football games in order to raise $2500. They are to purchase supplies to stock the stand and to set their selling prices. They are given a weather prediction, time of day and day of the week for the game, and other information on which to base their decisions. The computer then tells the student how much of each item they sold and what their profit was for this game and the profit for all the games so far.

This program teaches the student to think and to make decisions based on available information.

The graphics and directions are very clear. The support material is very good in offering suggestions for use and provides a worksheet to be used if desired.

Program Title: TEDDY

Disc Title: "Memory: The First Step In Problem Solving"

Source: Sunburst Communications, Inc.

Recommended Grade Level: 1 - 2

Reviewer:: Linda McCrone

Teddy is a beautifully prepared program designed for grades 1 - 2 which promotes and provides practice for skills in remembering order and sequence of events. Teddy is a teddy bear shown making his bed--step by step. Children playing "Teddy" must watch the screen carefully, watching the bear make his tiny bed step by step. After Teddy has finished making his bed, children are asked to remember exactly how the bed was made. Thus the child is asked to recall the sequence in which objects were placed on the bed. If a child gives a wrong answer, he is asked to "Try Again!"

Several levels of difficulty are provided. The graphics are appropriate for the suggested grade levels. The screen is uncluttered and adequate time is given to participate in "making the bed." The graphics and color are used quite effectively enabling the player to distinguish each bed part easily.

Along with the disk, an instruction manual is provided for the teacher. Sequential lesson plans are supplied along with an informational guide which lists skills and strategies that may be used in a classroom for the further development of problem solving skills.

Program Title: THE SIEVE OF ERATOSTHENES

Disc Title: "Factoring"

Source: Scholastic Microcomputer

Recommended Grade Level: 6 - Adult

Reviewer: Carol Beate

"The Sieve of Eratosthenes" shows the student how to find all the prime numbers between 1 and 200. These numbers (1 - 200) are all listed on the screen and it asks the student to find a number which is a prime. Then to find the first multiple of that number. All the multiples of that number are then shaded out on the screen. After finding all the composite numbers in this way, the student is left with only the prime numbers.

This program leads the student to find another method of identifying prime numbers. Rather than going through number by number, whole groups of numbers can be eliminated. The student finds the relationships between numbers.

It also discusses twin primes (primes differing by 2, such as 3 and 5), Palindrome primes (primes which are reversible, such as 101 and 191) and Goldbach's conjecture.

The graphics and directions are clear. Support material explains the objectives of the program and gives ideas for use.

Program Title: TRAVEL AGENT

Disc Title: "Survival Math"

Source: Sunburst Communications, Inc.

Recommended Grade Level: Jr. High - High School

Reviewer: Jean Eckert

The student is given a predetermined amount of money and he must make a choice among various modes of travel, motel accomodations, restaurants and types of meals and various forms of entertainment. The student must budget wisely to use all the allotted funds without overspending. This was an exciting program since it requires students to plan a vacation,--a real life skill. It involved many mathematical calculations in all four operational areas. When an incorrect response was given, the student was reminded of the cost of each item. The program would be excellent for intermediate, junior high or even high school consumer education.

Program Title: TRICKSTER COYOTE

Disc Title: "Trickster Coyote"

Source: Reader's Digest Services, Inc.

Recommended Grade Level: Age 8 up

Reviewer: Stephanie Garcia

Trickster Coyote is a vocabulary game. Instructions and warm-up activities are included.

The purpose of this program is to quickly and easily add new words to your vocabulary. Teachers may edit and put in their own vocabulary words. The program allows you to choose a list of words by level of difficulty.

The program's graphics are good, but overall, the program is uninteresting and awkward to use. Children are exposed to vocabulary words, but not in any meaningful context. It is simply more drilling.

The program is not self-paced, nor is it very motivating. When playing this I found I was paying too much attention to the coyote jumping over the loop, and not enough to the words and their meanings. Speed was very important in this game.

I would not recommend this game.

Program Title: VOYAGEUR

Disc Title: "What Would You Do? Simulations in Social Studies"

Source: Sunburst Communications, Inc.

Recommended Grade Level: 4 - 6

Reviewer: Dennis Works

This game is very similar to the Oregon Trail program but its graphics are not as effective. In this program, voyageurs travel in great canoes from Grand Portage in Lake Superior to fur trading lands. This happens during the 18th and 19th century. The goal is to travel in the shortest amount of time while collecting the most furs. There is an initial budget to spend on clothes, gunpowder, wine, flour and sugar, tobacco, and trading goods. Various obstacles along the way must be dealt with. Since goods may be traded and purchased in fractional amounts, the program is best suited for fourth grade upwards.

Program Title: WHAT IS A FRAME

Disc Title: "Memory: The First Step In Problem Solving"

Source: Sunburst Communications, Inc.

Recommended Grade Level: K - 2

Reviewer: Virginia Small

This is a game for young children. (They will need someone to read the directions to them.) A frame appears with objects in it. At the beginning of the game the player is told he or she has the choice of the number of objects that will be placed in the frame. The player also has the option of choosing the length of time he or she has to look at the objects. (10 seconds, 15 seconds, 20 seconds or until the space bar is pressed.)

The object of the game is to look at the objects in the frame for the length of time chosen. When the frame of objects disappears objects will reappear on the screen and the player presses Y for yes and N for no as to whether the objects had been in the frame. The score is given at the end of the game and the child is asked if he wishes to play again or select another game or disket.

This is a good game for young children The child is in complete control since he or she can choose the number of objects to view and the length of time to view them.

Program Title: WUZZLE

Disc Title: "Elementary Volume #7"

Source: Minnesota Educational Computing Consortium

Recommended Grade Level: Pre-school, Kindergarten, Special Education

Reviewer: Jill Frey

"Wuzzle" is a program designed to provide drill and practice in counting sets of 1 - 9 objects. Students must recognize the written numerals. Two sets of objects are presented in random order on the screen at a time. The student is asked to count one set at a time and then type in the answer. When the student gives the correct answer the Wuzzle jumps around. If the answer is incorrect the objects in the set flash slowly so that the student can recount them. If the second answer is also wrong the second set of objects disappears and the student recounts. When the third response is still not correct the answer is flashed on the screen.

The program is a drill and practice activity which may be used by an individual or a small group. The program is not accompanied by teacher support materials. It has only one level of difficulty.

Program Title: VISIT FROM SPACE

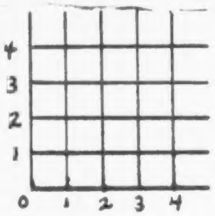
Disc Title: "Bumble Games"

Source: The Learning Company

Recommended Grade Level: 1 - 3

Reviewer: Connie Funkhouser

"Visit from Space" is a graphically nice and educationally sound piece of software. Directions are brief and to the point, and vocabulary is second and third grade level. Students are shown a grid or graph that looks like this:



The object is to find Bumble's cousin on the grid. The student takes a guess by typing a number from the bottom, then typing a comma, and then typing a number from the side. If their guess is incorrect, they are given a clue. A clue might be, "No, she is down and to the left." Students keep trying until they have found her.

Educational aspects are sound for this game. Students are exposed to problem solving, elimination processes, introduction to x,y coordinate graphing, directions (up, down, right, left), and the opportunity for success. This game could be used for reinforcement and enrichment in the classroom.

"Visit from Space" is self-motivating. The graphics are simple but colorful. Children will like it, and it will make them think.

SOURCES FOR EDUCATIONAL SOFTWARE

Conduit
P. O. Box C
Oakdale, IA 52319
(319) 353-5789

CUE Softswap
San Mateo County
Office of Education
333 Main Street
Redwood City, Ca 94063
(415) 363-5472

The Learning Company
545 Middlefield Road
Menlo Park, CA 94025
(415) 328-5410

Milton Bradley Company
443 Shaker Road
East Longmeadow, MA 01028

Minnesota Educational Computing Consortium
(MECC)
2520 Broadway Drive
St. Paul, MN 55113
(612) 638-0627

Sunburst Communications, Inc.
39 Washington Avenue
Pleasantville, NY 10570
(914) 769-5030
(800) 431-1934

Scholastic Microcomputers
900 Sylvan Ave.
Englewood Cliffs, NJ 07632

Reader's Digest Services, Inc.
Microcomputer Software Division
Pleasantville, NY 10570

Opportunites for Learning, Inc.
8950 Lurlene Ave.
Chatsworth, Ca 91311

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Highland, Illinois

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Edwardsville Junior High School
Edwardsville, Illinois

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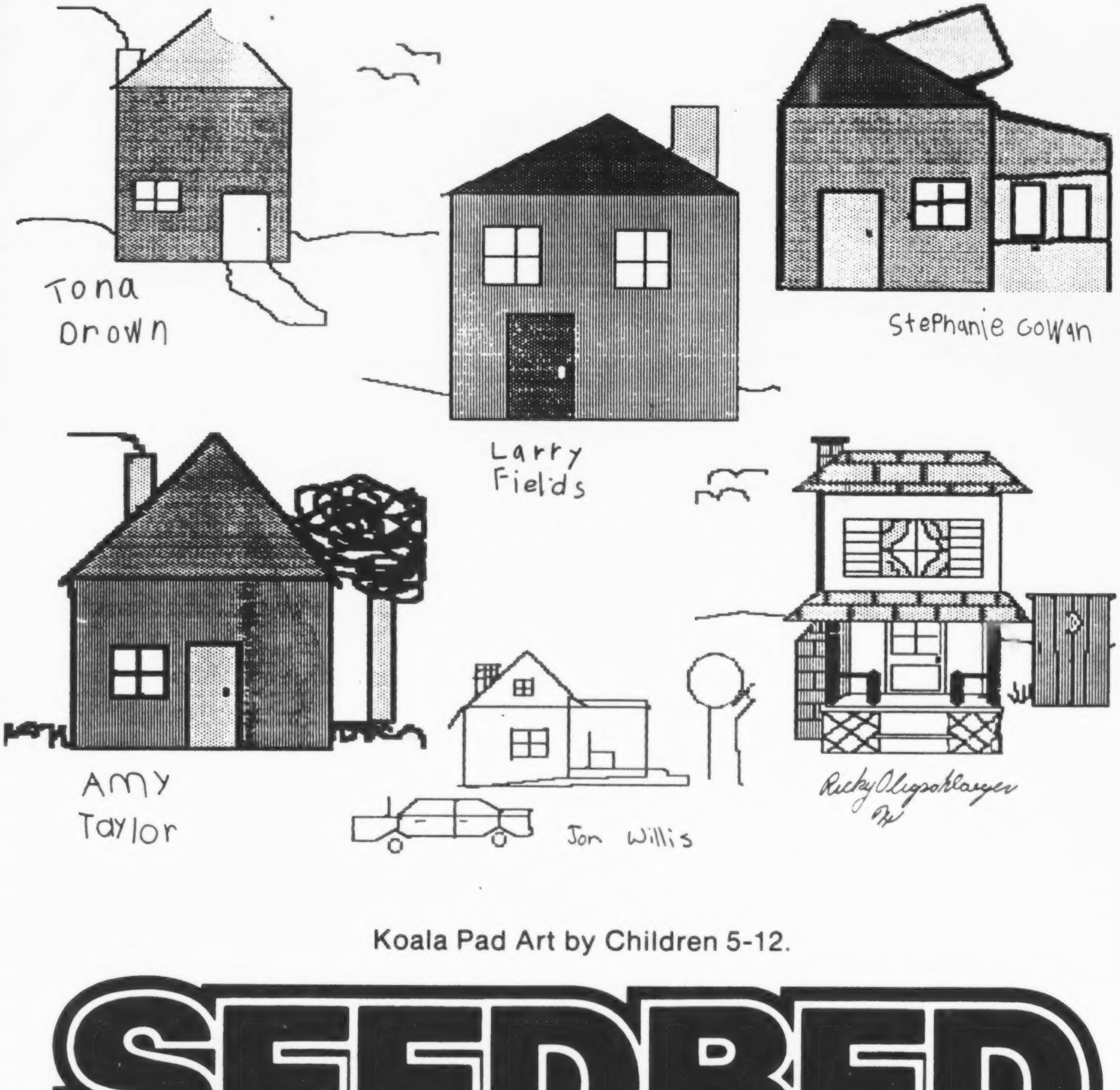
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Larry Fields
Stephanie Cowan
Amy Taylor
Jon Willis
Ricky Oligschlager

Koala Pad Art by Children 5-12.

SEEDBED

SEEDBED

NUMBER 18

April, 1984

Teachers' Center Project

SIUE

Southern Illinois University
at Edwardsville

1805

INTRODUCTION

This is a difficult introduction to write. With SEEDBED 18 and 19 Shirley Casey finishes 9 1/2 years with the Teachers' Center Project. If what follows appears to be tear-stained, you're right.

(Shirley Casey worked at SIUE for 9 1/2 years. Her salary at best was half of that of a first year New York City policeman. She was low person in the academic charts, despite having published and presented more, nationally and locally, than 90% of her SIUE School of Education colleagues. SIUE's recent fiscal crisis made her position shaky at best. September last, it was only within days of school's start that she knew that she had a job for the 1983-84 year. In November, her Bill -- out of work for three years thanks to the local economy -- took a job in Colorado. Shirley stuck around, Bill-less, to fill out commitments at SIUE and leaves now to catch up with her husband and to begin a new life.)

The 19 SEEDBEDs in which Shirley has been engaged as editor, mother-hen, and intellectual gardener have indeed represented a major breakthrough in American education. They have said, loud and wide, that teachers are capable of good and original educational thinking, that a point of view (rather than mere bits and tricks) is essential for teachers and for education in general, and that schools are for kids. Perhaps most important, they have said that knowledge is not a spectator sport.

About SEEDBED 18 and 19: Shirley is responsible for these two SEEDBEDs, but a great deal of credit is due as well to the teacher-authors whose work appears herein, and to Ed and Shirley Labinowicz (CalState/Northridge), many of whose seedlings gave rise to local teachers' research, development, and growth.

I hope that you will take some of these ideas and grow and try and bend them yourselves. As is usual with SEEDBED, what's here is not for passive reading but for action, action on behalf of children and on behalf of excellence in education.

It is commonplace to see a person off with a polite bureaucratic "Good bye and Good Luck. Back to business as usual." But the Shirley Caseys of the world are not commonplace, nor is this Shirley Casey a bureaucrat. Best to say this... Thank you, Shirley, for youruntiring efforts on behalf of children and teachers, for your good sense and your good ideas and your willingness to share them, and for your grace and your cheer and your personal sacrifice in the face of incredible local bureaucratic ineptitude. Education is NOT a matter of bureaucracies, as you know; it's concerned with people and ideas and their growth. You have touched thousands of lives of teachers through your work with the Teachers' Center Project and, through them, many thousands of lives of children.

Some years ago I asked the great George Polya, "What is a teacher?" "A teacher is the midwife in the birth of ideas," he said. "But what a teacher really teaches is himself. Whatever he or she is, the students will be."

Shirley, you are a person of quality; that's what you taught.

T. O'Brien

Thomas C. O'Brien, Professor
University City, Mo
7 March 84

ABOUT THE COVER

One of the main aspects of American education -- see SEEDBED 17 for further discussion -- is the advent of Computer Assisted Learning, something quite different from Computer Assisted Instruction where the teaching of some narrow specific is the goal.

And one aspect of CAL is representation -- from the Latin res praesantans, making a thing present. To make something present, through prose, music, or art is a major intellectual act.

Now tie together the two issues -- computers and representation -- and you've got something!!!

One of the computer accessories newly available is the Koala Pad*, a fabulously versatile computer accessory which enables one to draw with one's finger (or a stylus) on a touch-sensitive pad and the results appear on one's computer monitor. Don't like freehand drawing? Then tell the Koala Pad to draw lines, rays, frames, boxes, circles, and disks. Then fill the page you've drawn in color and save it on a computer diskette for future revision.

The cover of SEEDBED 18 contains Koala Pad art drawn by children** at Walnut Grove School, Florissant, and several pages inside contain pictures drawn by local teachers in my computers-and-education on-campus course. (This was the teachers' first five minutes at Koala!)

It's difficult to communicate the excitement that Koala Pad brings to people. One really must try it in person. We are pleased, though, to show off the Koala Pad creations in hopes that Koala Pad and other utilities of the sort may gain an increasing role in the present school curriculum.

-- T. C. O'Brien

*Koala Technologies, Santa Clara, CA

**Amy is 5, Larry 6, Stephanie 7, Tona 7, Jonathan 9, and Rick 12.

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THE FOUR ... IZATIONS

Tamas Varga

Dr. Tamas Varga, one of the most highly respected math educators in the world, is director of math education for the Ministry of Education, Hungary. It has been our good fortune that Dr. Varga was able to spend two lengthy visits with us as Teachers' Center visiting scholar. The paper that follows results from his month-long collaboration with the Project in the winter of 1982 - 3.

Let me start with telling you that I like America. I like the freedom of thinking and of speech, the free choice, the wide range of possibilities for everybody here. I like America. In fact, I love America. She became the second homeland for many of my earlier compatriots.

I like American schools, too. I visited some schools the other day and I have been involved with work with teachers for more than a month around here and quite a lot of times earlier (since 1967). I found most of these teachers resourceful persons, open to new ideas. Some of them are even brilliant, dedicated to their profession, real artists of the art of teaching. I like your clasrooms with the many challenging objects in them, with the various interest corners which match the changing interests of students and their individual needs.

Now that I have professed my fundamentally positive attitudes, in fact my profound feelings, I dare to complement the above by expressing my deep concerns about what I consider to be some negative features of American education.

Trying to compress into a few key words what I was going to say, I found these as reasonable approximations:

INFANTILIZATION
FRAGMENTIZATION
OVER SYSTEMIZATION
DYSFUNCTIONALITY

(I was tempted to use in the last word, too, the ending zation -- but I decided not to be too systematic.) Let me give some examples. They will not be related to the above four features one by one because I didn't find it possible to separate them; they are strongly inter-related.

I visited a kindergarten class. The teacher of the class is one of the most competent teachers I have ever met. The classroom is a little museum of natural sciences with such objects in it as a stuffed crocodile (a REAL crocodile), the rattle of a real rattlesnake, and many rare shells. In addition, there were picture books on animals, on reptiles, on shells. And so on and on. The kids loved the teacher. They appreciated the richness of the environment she created for them.

But now a reading lesson begins. They learn the letter A. They learn every letter of the alphabet during one whole week. Last week they learned of the letter F, personified by a big doll with Funny Feet. Now they are on A. The teacher follows a big book and the book tells her to teach kids these letters, each during a whole week. That is what she is supposed to do, that is what she is paid for. She complies with the prescriptions. Her affectionate personality softens the rigidity of these prescriptions. Maybe not every teacher can do it as well under such circumstances. Kids love her so they, too, comply. But they perform below their potential level. They are infantilized. During the same period they could learn maybe ten times more letters and their uses--not just one letter, but letters forming words, words expressing ideas and feelings, words in sentences related to their world. The teacher does everything to relate it to their world. The system impedes her. They may one day become interested in the various phonetical values of A. Some of the kids might embark on a project of finding several uses of the letter A, several ways of pronouncing it. Some of them might form a research team and find only two or three; others may get up to six or seven. Such a project would neither infantilize them, nor fragmentalize the holistic way of learning to read. To do so would mean diving deeply into the world of words as they are pronounced and as they are spelled. But such an approach would not comply with the prescriptions in the big book. It would not be sufficiently systematic. Hence, it would be out of the question. Long live the system: learning the letters one per week.

Maybe one day the spirit of systemization and fragmentization will reach music education, too. Then kids will learn of "do" one week, "re" next week, then "mi" and so on, instead of letting these words function as keys to comparing tunes, recalling and recording melodies and so on.

Maybe one day the wave of fragmentization and systemization will reach physical education. Somebody will develop a system of training the muscles one by one. One week would be devoted to the muscles of the little finger of the left hand, then another week of the ring finger on the same hand and so on. Five or six years would be enough to get to the toes, but by virtue of the system, eventually not a single muscle would be omitted: back muscles, abdominal muscles, cervical muscles, all would be covered by the "curriculum".

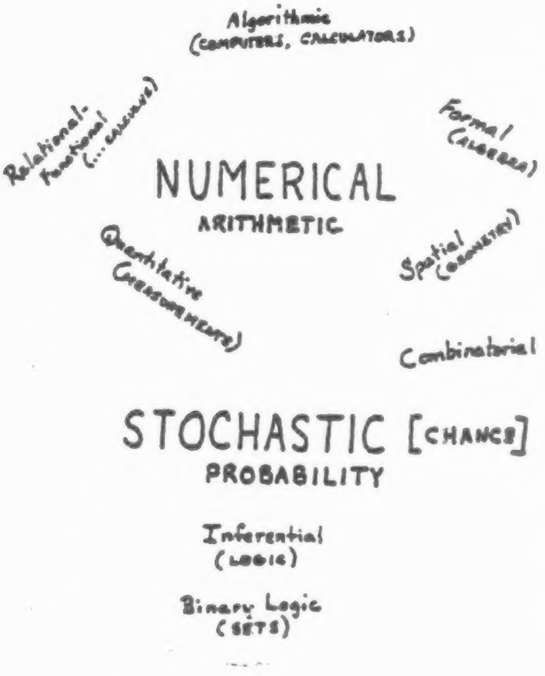
Maybe you find that I overstate my point and conjure up a ghost that does not exist. Well, maybe not in physical education, maybe not in music either. I don't know. I have not visited those classes. I hope not. But I am sufficiently at home in mathematics education to tell you the sad truth that this is what actually happens in mathematics education. To spend not just weeks but months and years with addition facts and subtraction facts and the like is not at all dissimilar from exercising the muscles of the fingers one by one instead of appealing activities which exercise the body in a harmonious way. Your present system of six, seven or eight years of dull arithmetic makes me think of those imaginary PE classes. No wonder that the mental muscles of students become gradually atrophied as would the physical muscles after those systematic PE lessons. This is what happens in American schools in mathematics education. (This is not only in America. You can find similar curricula in other parts of the world, but maybe in no place at such extremes as here.) The eight grades of arithmetic means exactly that--arithmetic--even though some of the bright students in the junior high may start pre-algebra in grade 7 and go on to algebra in grade 8 and geometry in grade 9 in high school. (But it is only the bright students.)

In the Soviet Union, the sixth grade was the starting of algebra until 6 or 7 or 8 years ago, when they realized the absurdity of that and developed ways of dealing with algebra from grade 4. In Hungary, we start (guess where?) in grade 1. We have done so because our philosophy is that mathematics is a whole and algebra is a part of it. Developing the algebraic way of thinking would be too late in grade 2.

Developing notions of chance, of probability, by discovery activities would be too late by grade 2. We start in grade 1. Everything we start in grade 1. I don't say that so far we succeed completely in this shift from the old fashioned curriculum to one with harmonical development of muscles of the whole body. We try to sell to our teachers. The way they were taught has a much greater effect on them than anything else they learn in their college education. So it's a difficult transition. But I think that the first step is to realize that American education will suffer enormously (not only mathematical education but education in reading and writing--that's why I brought my first example of the letters) from fragmentization and infantilization. Education in every subject is so much inter-related that if there is such a phenomenon in one part of the curriculum, then (in the most expressive, the most extreme) the whole of education must suffer.

Mental muscles become atrophied. What actually happens is not that they become atrophied but they are exercised mainly out of school. The interest of kids exists from birth and strengthening somehow happens whatever we do. But it happens out of school and the academic subjects often become obstacles of education instead of aids. We have a poet, Ady, who said (I will try to translate): "Life has holy reasons for life to go on." So life, growth, goes on even if conditions are not very good--but it goes on largely out of school. So why not promote it in school?

Kids from their birth develop their emotional, intellectual, physical (and so on) abilities and within them the mathematical ones. They are not just cognitive. They are related to the affective side. Within mathematics are all of these.


Algorithmic
(COMPUTERS, CALCULATORS)
Relational-
functional
(...CALCULUS)
Formal
(ALGEBRA)
NUMERICAL
ARITHMETIC
Quantitative
(MEASUREMENTS)
Spatial
(GEOMETRY)
Combinatorial
STOCHASTIC [CHANCE]
PROBABILITY
Inferential
(LOGIC)
Binary Logic
(SETS)

Arithmetic is written in heavy letters in the middle--it's important. I don't say it should be neglected. But I do say that if mathematics as a whole is being developed--if kids are being developed in mathematics as a whole, then the numerical aspects, the numerical muscles will be being exercised better than if we systematically do only the numbers--only the numerals. Numbers are related to all those--to the algorithmic aspect, calculators, computers. It's important to develop algorithmic thinking, relational thinking, functions leading to calculus and formal thinking. It's important to introduce letters, but not only for numbers. We use letters for movements and geometric transformations. It's important to inter-relate the numerical aspects and the spatial aspects as we do in using numbers to express measurements. Numbers are first counting numbers, but later become measurement numbers. They grow out of the quantitative sort of reasoning and become combinatorial. I will give you an example of the stochastic. Again I am using letters to stress the importance of the inferential aspect--binary logic--yes or no, T or F, "within the set" or "outside the set". That's all nonsense. We've heard that for 20 years in the revolution in school mathematics--the new math. What came out of it? It would be better if we went back to the old, timehonored mathematics (arithmetic)? Why not do that? If new math is measured by the effect it has had on American education, then forget it!

But new math may not only mean that. Traditional mathematics and new mathematics are not very different from each other. What other alternative could be out there? How far could it go?

What is new math? I was looking for a book in the library called Sets and Numbers. On the first page of that book you see funny animals, elephants and lions, playing musical instruments and dancing. Some of them are seen in curly brackets. Written after this is "This is a set." Below that, still on the first page, are the animals without those brackets. After them is written, "This is not a set." When the child turns the page, he finds there the same things--animals within brackets and animals without brackets. The question is, "Is this a set?" The child is to place a check mark in the appropriate place. Those who wrote the textbook have the naive belief that those kids will eventually understand what sets mean. What do they actually learn? An example shows it clearly. A child was asked by his parents, "What were you learning about mathematics today?" "We learned about sets." "What are sets?" The child started to think how to explain what sets are and finally he explained it by showing the curly brackets--using his arms as brackets. "These are sets," he said. That was his idea about sets and that's the essence of new mathematics in one sense--being about poorly understood symbols. Mathematics is not about symbols. You use symbols only after you have understood something. You use words when you need symbols to express an idea you have already understood. The words, the symbols, are used as tools for manipulating ideas. That's why the trend of new math, for the large part, failed. And now the trend is to go back. I don't think that's the direction to go.

Now let me give you a few examples. These are dice with colors instead of numbers on them. The same six different colors are on each of the cubes. We could ask, "What do you think we'll see if we throw five of these color cubes? How many different colors will show? Three colors? Three black, a blue and a red? Will that happen again? Often? What do you think? What are the possibilities?" If we ask that, of course, the possibilities are 1 color, 2 colors, 3, 4, 5 colors. And 3 colors can not only happen to be 3 black, 1 blue, 1 red--we could have 2 of one color, 2 of another color and 1 of a third color. This part of the thinking is combinatorial. What are the possibilities? And the other part is probability. Which do you think will happen most frequently? The students express their feelings, their hunches, their estimations. They estimate. Then they go on to measure. How can we measure probability? We can perform the experiment often, record and tally the outcome and that will be a measurement of the probability. One can repeat the measurement just like you can repeat a measurement with a yardstick. The result of each measurement is not exactly the same. There is an error in actual measurement. They do the measurement many times and go on to build their theory. The theory here is rather complicated. But there are cases where the theory is so simple that kids themselves can develop the theory--the reasoning which explains why something happens more or less frequently. I'll show you with three coins:

Suppose I toss three coins. Each of them can be a head or a tail. It is easy to see that with two coins you can get two different results--both the same (both heads or both tails) or both different. Now with three coins you cannot get three different results. If the first two are both heads, you can get a head for the third coin, giving all same. Or the third could be a tail, giving a mix. This also happens if the first two coins are tails. The third could be a tail, giving all the same. Or it could be a head, giving a mix.

If the first two coins are a mix, the third must be a head or a tail. So there cannot be three different outcomes, only two: same and mixed.

So there are two possibilities. Two of the three coins must be the same. Perhaps all three turn out to be the same. If you have three coins, two of them must be equal. The third one must make a same or a mixed.

What do you think about it? Is the chance of getting same equal to the chance of getting mixed if three coins are tossed? It looks as though it is.

Could we try it? Could you take three coins and toss them? Do it 20 times. What do you think? You problably expect that in about half the cases you'll get same, in about half the cases you'll get mixed. Maybe not exactly half but roughly half. Try it?

Could you tell me your results? How does our theory get verified, or fortified, by the results?

TWENTY TOSSES OF THREE COINS

Same	3	4	4	3	6	4	5	6	6	8	2	6	4	5
Mixed	7	16	16	17	14	16	15	14	14	12	18	14	16	15

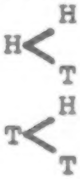
Well! Why did the experiment turn out different from what we predicted? It's not impossible for results to differ from predictions. They always do, somewhat. But here the results are so far from our prediction of half and half that something is very suspicious. It may be that we should look at the theory again. If one coin is tossed, the result can be head or tail.

One Coin

H
T

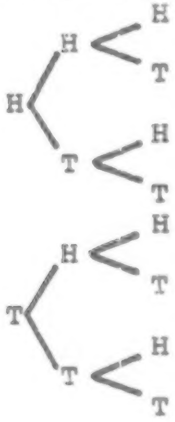
If two coins are tossed we get this

Two Coins



And if three coins are tossed, we get the following situation:

Three Coins



So there are eight equally likely cases, two of them yielding same (HHH and TTT) and six yielding mixed. Our theory was in fact wrong. The probability of same is 1/4 and the probability of mixed is 3/4. And if you check the experimental results, you will find roughly the same ratios. The new theory matches the experimental results.

It's not impossible to have experiences that are far from the theory, but it's rare. This makes one suspicious that something is wrong with the theory.

Kids learn this device of building a theory, becoming theory builders. They are shocked when their experiences are contrary to their preliminary beliefs. That's a high level of working--higher than working out multiplication and division problems in far more time than a calculator could. That's another question (whether you have to learn arithmetic in that way in the age of calculators). That's another discussion.

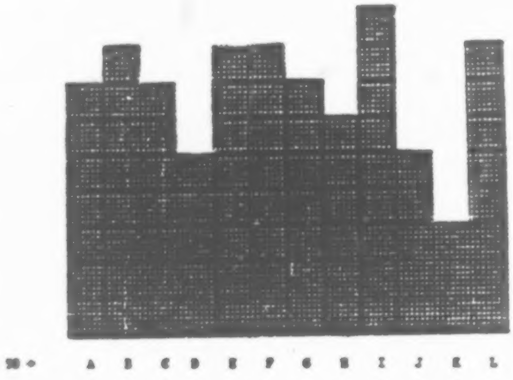
Let me show you something different about combinatorials. Kids can use Unifix blocks and build towers of them, using two colors to make three-story buildings. How many such buildings can they make? Then they build two-story buildings using three colors. What do you think will be the result? How many different buildings can be made?

In these cases, the guesses will actually happen--the guess is exactly what will happen. In a probability experiment, the outcome can be different, but in a combinatorial problem, the outcome is exact. We may start by asking them to make as many buildings or towers as possible. If somebody finds six of the possible buildings, that's good. If she finds seven--better! And if she can explain why there will not be more than eight, still better. There are good, better and still better answers--not just one good answer. They start to look for the patterns--how many are there of just one color? How many of three colors? They may find that this is the same thing as we have here. It's the same as "HHH" or "White, White, White" or "TTT". They understand the sameness of the two seemingly different situations and they see that there are two white--one black and two black--one white. So they have the 1 - 3 - 3 - 1 pattern. These numbers become important for them--Pascal's Triangle. That's all very elementary--not beyond the ability of the 6-7-8-9 year old. They approach it in various ways but all that, though very elementary, leads to a learning of a very high level. That's also connected with reading because if they start to order, to arrange in some order, they will find a sort of alphabetic order that corresponds to AAA or AAB in a dictionary or encyclopedia. The way words are ordered is exactly the same way as we order the possible outcomes here to convince ourselves that there are no more possibilities. So, reading and arithmetic (or not just arithmetic), mathematics (combinatorials in this case), are related in this way just as probability and combinatorials are related.

I will show you just one more thing and I will conclude with that. Here are some children. They are in alphabetical order. I'll call them A, B, C, D, E, F, G, H, I, J, K, L and so on. Their heights are expressed by the lengths of these Cuisenaire rods -- inches above 50.

Figure 1

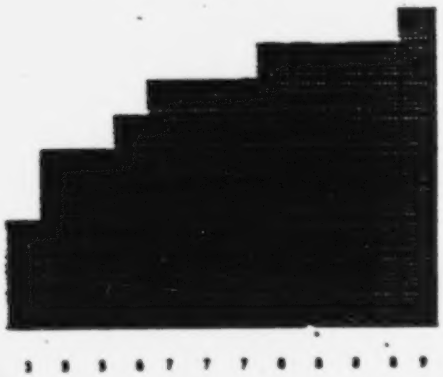
Children's Heights (inches above 50)
In Alphabetical Order



A is 57, B is 58 and so on up to L, who is 58. Then they change their order and in increasing order these are their heights.

Figure 2

Children's Heights (inches above 50) in Increasing Order

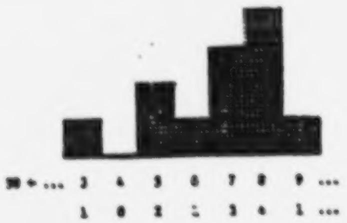


The smallest is 53 and the tallest is 59. That's fine. The children can record that. They can use the Cuisenaire rods or something else to record. That's something very concrete. What comes now is more abstract.

These are their heights. How many of them are 53? There is just one. Now the next would be 54 and there are none of them at 54. So that place remains empty. How many are 55?--2. How many are 56?--just 1. 57?--3, 58?--4, 59?--1 and then zero--no more. No one is shorter than 53 and no one is taller than 59. That's more abstract.

Figure 3

Frequency of Heights (inches above 50)

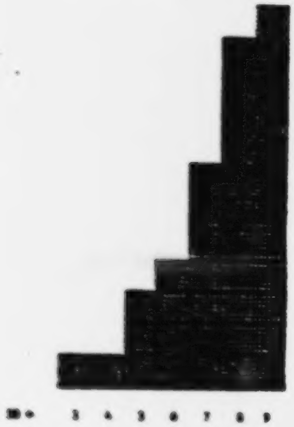


Now something still more abstract comes. It is a difficult concept. I don't ask now, "How many are this or that height?" but, "How many are this or that height or less?" So one is 53 and no one is 54.

Therefore, one is 54 or less. Two are 55, so how many are 55 or less? 2 + 1 = 3! One is 56. How many are 56 or less? One more! How many 57 or less, 58, 59 or less?"

[illegible]

[illegible]

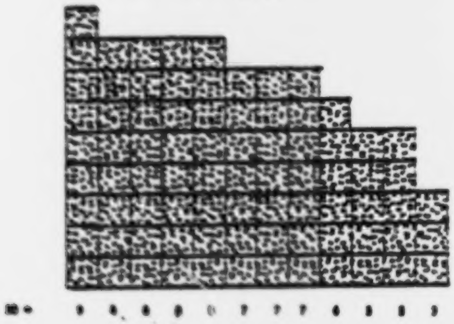


Again this is a very difficult concept, but it is related to their world--it is in a familiar range of ideas. It's easier for them to grasp the idea this way. It depends to an extent on age, but it also depends on how their mental mathematical muscles were exercised prior to that. It's not only age. They give this:

[illegible]

[illegible]

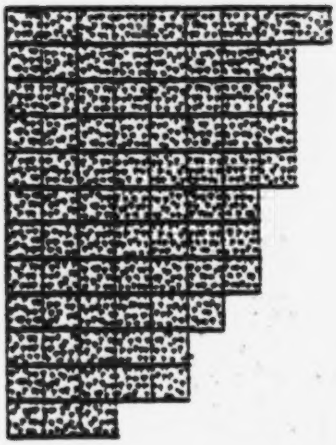
[illegible]



rotate it,

Figure 6

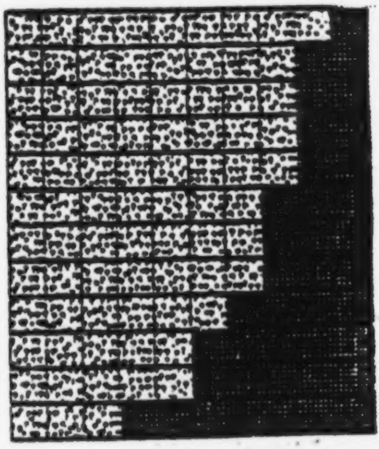
90° Rotation of Figure 5



bring back Figure 4,

Figure 7

Complementary Relationship Between
Figure 6 and Figure 4



and lo and behold, it fits. Why? The "why" in mathematics is almost always there and that's not a question that can be answered easily! There is not one correct answer. There are different ways of explaining that. We understand that the physical fitting of these two has something deep behind it. Try and concur this deep idea. That is what makes the mental mathematical muscles develop. They are challenged and they try, they discuss, they are learning. So that sort of mathematical learning and that sort of learning in every subject is what would eventually make those features which I expressed by those ugly words (sorry I couldn't find better words) INFANTILIZATION, FRAGMENTIZATION, OVER SYSTEMIZATION and DYSFUNCTIONALITY, disappear. I wish you good success in eliminating these features. Thank you.

At the end of Varga talk:
O'Brien: I'd like to make a couple of comments. What Tom was talking about with respect to mathematics curricula (I think he would be the first to agree) applies to schooling in general. Mathematics just happens to be his speciality.
There's been a great deal of attention given in the American press to basics. What is basic in the education of a child? I suggest that the issues that he discussed with you are basic and I'd like to

summarize them.

He was talking about theory building. He was talking about theory testing. He was talking about theory revision. (One of the papers available from the Teachers' Center Project is by Mimi Sinclair for the University of Geneva. It's called "The Child As Scientist". Professor Sinclair is one of the leading psycholinguistics researchers in the world and in that paper, done for the Teachers' Center Project, she talks about the child as a theory builder and a theory tester even as an infant.) That's basic.

In these activities that Tom did with you, you worked with record keeping, tree diagrams, combinatorics; in general, organizing, forming a mental picture of the environment around you. That's basic. That's what kids do from birth on up. One of the major aspects of being human is that we organize.

A terribly rich issue that Tom brought to my attention when he first arrived is just one sentence and that's going to take ten years to flesh out. "Much of present day education is concerned with logical necessity." All right. But a lot of what happens in our world deals with probability and chance. Maybe the bus won't show up. Maybe the coffee won't be served. Maybe I'll drive home safely. Shouldn't we give some attention not only to logical necessity but also to the whole issue that surrounds our every moment--the issue of chance? This is not a trivial point to raise.

INTERVIEW REPORT

Barbara J. Maue

The students that I interviewed ranged from third grade to sixth grade. The activities were identical for all ages and it was interesting to see how they handled the tasks in relation to their level of learning. The students were as follows: Third grade - Beth, Jackie, and Julie; Fourth grade - Amy; Fifth grade - Tracy and Bria; Sixth grade - Lynn and Andy.

Task 1

The students were given a set of eight number series. They were told to figure out the sequence of the numbers and insert the next number in that sequence. Here are the results:

NUMBER LINE	Julie	Beth	Jackie	Amy	Tracy	Bria	Andy	Lynn
A. 2,4,6,8,? (10)	10	10	10	10	10	10	10	10
B. 2,3,5,6,8,? (9)	10	11	9	9	9	9	9	9
C. 10,25,40,55,70,? (85)	15	85	85	85	85	85	85	85
D. 155,165,175,185, 195,? (205)	196	205	200	200	200	205	205	205
E. 103,105,106,108, ? (109)	110	111	109	110	109	110	109	110
F. 126,120,114,108, 102,? (96)	96	96	100	100	96	96	96	96
G. 1953,1952,1947, 1946,1941,? (1940)	?	1938	1940	1940	1940	1938	1940	1940
H. 598,590,583,575, 568,? (560)	?	571	557	575	560	561	560	560

Andy understood the concept well and picked the sequences out very easily. He finished the eight lines very quickly and explained his work well, with just a small hesitation when the order of numbers reversed. Lynn, Tracy, and Bria worked very confidently and seemed to pick up on the sequencing, but overlooked the fact that some of the lines switched in their sequencing. The line may have skipped eight; then seven; then eight, etc. They looked no further than the first skip of eight and decided that was the sequence throughout. Tracy worked quickly at first, but struggled when the sequence reversed.

Beth, Amy, and Jackie started well, but soon became confused and basically started to guess. Jacke picked the answer of 200 in Line D because 200 follows 195 when counting by five. In Line F she simply saw even numbers and picked 10 because it follows 102 counting backwards. Beth saw Line C as having a number without five, with a five, without a five, etc.: and chose 85 simply because it ended in a five. She got the answer right but didn't see the skip 15 sequence. Beth would put small slash marks on her paper to help herself count. In Line H Amy counted forward instead of backward. Amy was very easily distracted and had a hard time concentrating on the task.

Julie seemed totally lost after the first line, became very fidgety and finally gave up. She used her fingers to count and desperately wanted me to give her the right answers. In Line C she found the sequence but instead of adding 15 to the last number, she simply put 15 for her answer. She became totally frustrated when the order reversed and gave up. Julie's favorite line was, "I can't seem to get this one".

Task 2

This task was actually a series of manupulative exercises using Unifix blocks. In the first exercise the students were each given ten blocks and told to be sure they had ten and build them into a stack. After constructing the stack, they were given four more stacks of ten followed by four single blocks for a total of 54 blocks.

All of the students correctly counted 54. Jackie, Lynn, and Andy did not count each individual block in the stacks given to them, but took it for granted that each of them contained ten blocks. Bria counted the first set of ten she was given but not the rest. Beth, Tracy, Julie, and Amy all counted each stack carefully to be sure there were ten blocks in each. Julie continued to ask, "Are there ten in here?" When stacking the ten blocks initially given to them, Tracy and Lynn were very careful with the color combination of the stack.

In the second exercise, the students were asked to place their 54 blocks into stacks of 3 and stacks of 8. Jackie, Tracy, Bria, Andy, and Julie all took their stacks of ten, took one block off and divided the remaining nine into three stacks of three. On the other hand, Beth, Amy, and Lynn just broke the stacks up and built their stacks of three randomly. After they had put their 54 blocks into stacks of three, I asked how many stacks of three they had. Jackie, Beth, Bria, Lynn, and Amy counted each individual stack. Tracy and Julie tried dividing 54 by 3 in their heads. Both gave up and counted the stacks. Andy explained very confidently that 54 divided by 3 equals 18 stacks.

When putting the 54 blocks into stacks of eight, Beth, Julie, Lynn, and Amy recounted each eight after they had constructed it. Beth did her counting out loud. The other four students constructed their stacks quickly and confidently.

After building the blocks into stacks of eight, the 54 blocks were transformed into six stacks of eight blocks and six individual blocks left over. We put the six individuals aside. I then asked them to give me half of what they had. All of the students, except Beth, simply gave me three of their stacks of eight. Beth, on the other hand, took each stack of eight, broke it in half, and gave me six stacks of four. Again I noticed that Lynn was very aware of color arrangement when she stacked her blocks.

The next exercise involved converting their blocks to money. In front of them, the students had three stacks of eight blocks. I asked them to give me the total money they would have if each block represented a nickel, a dime, a dollar. Here are the results:

Student	Nickel ($1.20)	Dime ($2.40)	Dollar ($24.00)
Jackie	15¢	30¢	$ 3.00
Julie	$1.20	$2.40	$ 24.00
Beth	30¢	60¢	$ 7.00
Amy	30¢	60¢	$ 3.00
Tracy	$1.20	$2.40	$2,400.00
Bria	$1.20	$2.40	$ 24.00
Lynn	$1.30	$2.40	$ 24.00
Andy	$1.20	$2.40	$ 24.00

Jackie took each of the three stacks and multiplied it by 5c, 10c, and $1.00.

Beth counted each stack by 10c for nickels; doubled that number for dimes, and couldn't explain how she got her dollar amount. Amy was very similar to Beth, except she counted each stack as one dollar for her dollar amount.

Tracy calculated her nickels by figuring 8 x 5 x 3, and dimes by figuring 8 x 10 x 3, but reasoned that there are 100 pennies in a dollar so if there are 24 blocks, each block should be multiplied by 100 -- therefore $2400 for her dollar amount.

Bria and Lynn knew the right calculation, but came up with a couple of wrong answers due to miscounting.

Andy's answers were almost immediate, while Julie calculated slower but still answered correctly.

Jackie, Amy, and Beth used the blocks and counted 5, 10, 15, etc.; 10, 20, 30, etc.; $1, $2, $3., etc.

Julie used the blocks to count her nickels and dimes, but immediately answered 24 when asked about dollars. Tracy, Bria, Lynn, and Andy all calculated 24 x 5, 24 x 10, and 24 x 1 in their heads.

Next, they were asked to find out how many 6 paks, 8 paks, and cases of soda could be gotten out of their 24 blocks, if each block represented one bottle or can of soda.

Both Jackie and Amy counted each stack as one pak whether it contained six or eight blocks. Beth only heard the number six in 6 pak and said there would be six - 6 paks.

The other students came up with the correct answers in one of two ways. Julie and Bria divided the cubes into stacks of six and stacks of eight. Tracy, Lynn, and Andy figured 24 divided by six and 24 divided by eight in their heads. None of the students, except Lynn, knew how many sodas were in a case. Here are the results of this task:

Student	6 pak (4)	8 pak (3)	Cases (1)
Jackie	3	3	?
Julie	4	3	?
Beth	6	3	?
Amy	3	3	?
Tracy	4	3	?
Bria	4	3	?
Lynn	4	3	1
Andy	4	3	?

The interviews were both interesting and fascinating. Children have a very simple way of dealing with things. They use the resources available to them at the time and can't seem to go beyond that.

Some of the children, although the same age, have progressed much further than others and find tasks such as these much simpler. If I had to summarize my experience and how it relates to learning, I would have to say that in order to learn, a child must be given a challenge and given time to master that challenge.

MY FIRST TEACHER, OUR LAST VISIT

Jane Vandersand

"Did you see any quail?" she asked softly as I approached her bedside.

"No Grandma, but I could hear them saying "Bobwhite" as I came in."

"I thought so. I can hear them too."

My mind questioned briefly how that was possible. The windows of the hospital weren't meant for opening.

"Did you walk or ride?" It was a silly question to a hallway passerby, but one I had been asked countless times before. As a child, I lived only 2 streams, 3 small hills, and a plum tree away from Grandma. My walking always pleased her.

"I rode this time, Grandma."

We visited. She spoke, sometimes in the now and sometimes from the past. She spoke with a charming wit in both time frames.

I took the 92-year old hand of my first teacher who let me hold speckled robin eggs, who encouraged me to explore her musty garret, who helped me weigh myself on the huge feed scales in the barn. I kissed my first teacher who years later taught my own children. As they sat at her feet, they talked about her black horse, Dolly, and her first little buggy with a fine leather seat, about raccoons, and where to find lizards.

In the hospital parking lot, my own kids had been waiting for me.

"How's Great-Grandma?" they asked. "Is she going to die?"

Beyond the parking lot a misplaced country bird called "Bobwhite."

"Did you hear that quail?" my youngest whispered loudly.

My spirit lifted. My mind and body smiled. Good teachers live on through their questions!

1833

THE THIRD WAVE

Linda V. Dabbs

The following paper expresses Alvin Toffler's views on education as he expressed them in his book, The Third Wave. All statements are either paraphrases or direct quotes from this extremely well written book.

The book is based on what Toffler calls the "revolutionary premise." It assumes that even though the decades immediately ahead are likely to be filled with upheavels, turbulence, and even violence, we will not totally destroy ourselves. It assumes that the jolting changes we are now experiencing are not chaotic or random but that they form a sharp, clearly discernible pattern. This book flows from the assumption that we are the final generation of an old civilization and the first generation of a new one. Also, much of our personal confusion, anguish, and disorientation can be traced directly to the conflict within us and within our political institutions.

Every civilization operates in and on the biosphere, and reflects or alters the mix of population and resources. Every civilization has a characteristic techno-sphere, which is an energy base linked to a production system which in turn is linked to a distribution system. Every civilization has a socia-sphere consisting of interrelated social institutions. Every civilization has an info-sphere, which are channels of communication through which necessary information flows. Every civilization has its own power-sphere.

Why did Toffler select waves for his title? The wave idea is not only a tool for organizing vast masses of highly diverse information. It also helps see beneath the raging surface of change. Once Toffler began thinking in terms of waves of change, colliding and overlapping, causing conflict and tension around us, it changed his perception of change itself. In every field, from education and health to technology, it became possible to distinguish those innovations that are merely cosmetic from those that are truly revolutionary.

The First Wave, which was the agricultural phase, began sometime around 8000 B.C. and dominated the earth unchallenged until sometime around A.D. 1650 - 1750.

In families of the First Wave agriculture was the mainstay. People tended to live in large, multigenerational households with all members working together as an economic unit. As the Second Wave began to move across First Wave society, families felt the stress of change. As economic production shifted from the field to the factory, the family no longer worked together as a unit. Education of the child was turned over to schools. The new society needed mobility. The so-called nuclear family -- father, mother, and a few children -- became the standard.

As work shifted out of the fields and the home, children had to be prepared for factory life. Mass education was a result of Second Wave societies. Built on the factory model, mass education taught basic reading, writing, and arithmetic; a bit of history; and other subjects. There was also an invisible curriculum of punctuality, obedience, and rote, repetitive work.

Thus, from the mid-nineteenth century on, there was relentless educational progression. Children started school at a younger and younger age, the school year became longer and longer, and the number of years of compulsory schooling increased. Second Wave schools machined generation after generation of young people into a pliable, regimented work force of the type required by electromechanical technology and the assembly line.

Taken together, the nuclear family and the factory-style school formed part of a system for the preparation of young people for roles in industrial society.

Every civilization has a hidden code that runs through all its activities like a repeated design. The most familiar of these Second Wave principles is standardization. To prepare youth for the job market, educators designed standarized curricula. The standardized intelligence test was devised. School grading policies, admission procedures, and accreditation rules were similarly standardized.

A second great principle that ran through all Second Wave societies was specialization. Specialization was accompanied by a rising tide of professionalization. All sorts of occupational groups clamored for the right to call themselves professionals.

A third principle was synchronization. Children in industrial cultures were taught to tell time at an early age. Pupils were conditioned to arrive at school when the bell rang. Children began and ended the school year at uniform times.

Big government grew out of the driving need for the integration of Second Wave civilization. By setting up mass education systems, governments helped to machine youngsters for their future roles in the industrial work force. By relieving the family of educational and other traditional functions, governments accelerated the adaptation of family structure to the needs of the factory system.

The educational system was flooded with construction funds at precisely the moment when school-age population began to plummet, thus provoking an orgy of useless school building, followed by a cutoff of funds when they are most desperately needed for other purposes.

In 1973 when OPEC choked off the world's supply of crude oil, it sent the entire Second Wave economy into a down-spin. OPEC accelerated a revolution that was already brewing in the Second Wave techno-sphere.

Second Wave systems are in crisis, and this crisis is in all areas including school systems. The collapse of Second Wave civilization has created a personality crisis. The victims itch for change, but are terrified by it. It is the Third Wave of change that will frame the rest of our lives.

This Third Wave brings a new way of life based on diversified, renewable energy sources, on methods of production that make most factory assembly lines obsolete, on new, non-nuclear families, and on radically changed schools and corporations of the future.

The Third Wave raises concerns about education. Education is central to development. Today Second Wave educational models are being questioned everywhere. The Third Wave challenges the Second Wave notion that education necessarily takes place in a classroom. Today we need combine learning with work, political struggle, community service, and even play. All our conventional assumptions about education need to be re-examined both in the rich countries and the poor.

Is literacy an appropriate goal? If so, what does literacy mean? Does it mean both reading and writing? At a futures research center in Edinburgh, Sir Edmund Leach has argued that reading is easier to learn and more useful than writing, and that not everyone needs to learn to write. Speech recognition technology opens incredible new vistas. Tiny tape recorders built into simple agriculture equipment may ultimately be able to give oral instructions to illiterate farmers. In light of this, even the definition of functional literacy requires fresh thinking.

The Second Wave brought with it a "code book" of principles or rules that governed everyday behavior. Today a counter-code book is emerging. Many of the seemingly senseless conflicts in our classrooms are nothing more than clashes over which code book to apply.

The new code book directly attacks much of what the Second Wave person has been taught to believe in -- from the importance of punctuality and synchronization to the need for conformity and standardization. Today because the Third Wave brings with it personalized instead of universal or massified schedules, the consequences of being late are less clear. It is harder for young people to tell when punctuality is really important and when it is demanded out of mere force of habit, courtesy, or ritual. Punctuality becomes situational.

The Third Wave also attacks the Second Wave pattern of standardization. The hidden code of Second Wave society encourages a steamroller standardization of many things. The "back-to-basics" movement in the United States schools is to restore and enforce Second Wave uniformity. Legitimately outraged by the disaster in mass education, this movement does not recognize that a de-massified society calls for new educational strategies. The thrust of Third Wave change is toward increased diversity, not toward the further standardization of educational methods.

During Third Wave civilization, no single form will dominate the family mix for any long period. The most striking change will probably be the shift of work from both office and factory back into the home. The home will re-emerge as a central unit. This unit will enhance educational functions. There will be a high variety of family structures. As the Third Wave sweeps in, the family is becoming de-massified right along with the production system in society.

With the help of the computer, more work can be moved out of the office and into the home. Toffler calls this situation the "electronic cottage". Relocating work into the home means that many spouses who now see each other only a limited number of hours each day would be thrown together more intimately. The spread of work-at-home on a large scale could not only affect family structure but transform relationships within the family structure.

Children would grow up differently in this electronic cottage, because they would actually see work taking place. Second Wave children were segregated in schools and divorced from real work life. Today most children have only a foggy notion of what their parents do or how they live while at work. Today children are divorced from one of the most important dimension of their parents' lives. In an electronic cottage kids not only observe work, they may engage in it themselves. Second Wave restrictions on child labor become more difficult to enforce in the home setting. Certain forms of work may be integrated with their education. Individuals cannot enjoy the benefits of widened family options so long as school arrangements remain implicitly biased toward the Second Wave family.

In the new info-sphere kids raised in a smarter environment might make smarter people. A kid raised in a smart, responsive environment, which is complex and stimulating, may develop a different set of skills. If kids can call on the environment to do things for them, they become less dependent on parents at a younger age. They gain a sense of mastery or competence. And they can afford to be inquisitive, exploratory, imaginative, and to adopt a problem-solving approach to life.

The real impact of the Third Wave changes will not be felt until the new technologies have been combined. These technologies are computers, electronics, new materials from outer space and the oceans, and new energy bases. Bringing these elements together will release a flood of innovation. The Third Wave technologies have not yet been deployed on a grand scale. At present due to the perils associated with the advance of a new technological base, there has been a massive public resistance to new technology. Today's rebellion against runaway technology involves a fast-growing army of people who are not necessarily anti-technological, but who see in the uncontrolled technological thrust a threat to themselves and to global survival.

This group could be called the techno-rebels. They start from the premise that the earth's bio-sphere is fragile; and that the more powerful our new technologies become, the higher the risk of doing irreversible damage to the planet. The techno-rebels have not as yet formulated a clear, comprehensive program. They argue that either we control technology or it controls us. The techno-rebels are disturbed by the radical imbalance of science and technology. They favor devoting more technological attention to the needs of the poor and a more equitable sharing of the resources of outer space and the oceans. Taken as a whole, the techno-rebel program provides the basis for humanizing the technological thrust.

To operate the new Third Wave factories and offices of the future, companies will need workers capable of discretion and resourcefulness rather than rote responses. Employers will need men and women who accept responsibility, who understand how their work dovetails with that of others, who can handle ever larger tasks, who adapt swiftly to changed circumstances, and who are sensitively tuned into the people around them. To prepare such employees, schools will increasingly shift away from present methods still largely geared to produce Second Wave workers for highly repetitive work. The forces of the Third Wave fight for less standardization and more individualization in the schools.

The Third Wave encourages us to look behind conventional Second Wave assumptions with respect to motivation. Better nutrition is likely to raise the entire level of intelligence and functional competence among millions of children. At the same time it should increase drive and motivation.

Because many features of Third Wave civilization are consistant with those of First Wave civilization, they imply the possibility of change with less, not more, disruption, pain, and future shock. Therefore, they may strike at the roots of what we have called demotivation.

It is the entire civilization along with its institutions, technologies, and culture that is now disintegrating under an avalanche of change as the Third Wave surges across the planet. We live in the final, irretrievable crisis of industrialism.

Families should be encouraged to take a larger role in the education of the young. Parents willing to teach their own children at home should be aided by schools, not regarded as freaks or lawbreakers. Parents should have more, not less, influence on the schools.

Much could be done by the school to create a sense of belonging.

Instead of grading students purely on individual performance, some part of each student's grade could be made dependent on the performance of the class as a whole or some team within it. This would give early and overt support to the idea that each of us has a responsibility for others.

In education, we need to begin paying attention to matters routinely ignored. We spend long hours trying to teach a variety of courses on the structure of government, or the structure of the amoeba. But how much effort goes into studying the structure of everyday life, the way time is allocated, the personal uses of money, or the places to go for help in a society exploding with complexity? We take for granted that young people already know their way around our social structure. In fact, most have only the dimmest image of the way the world of work or business is organized. Most students have no conception of how their own schools are structured, let alone how such structures are changing under the impact of the Third Wave.

Living in work-at-home families suggests a shorter childhood and youth but a more responsible and productive one. Working alongside adults, children are also likely to be less subject to peer pressures. They may well turn out to be the high achievers of tomorrow.

We can expect education to change. More learning will occur outside the classroom. Despite the pressure from unions, the years of compulsory schooling will grow shorter, not longer. Instead of rigid age segregation, young and old will mingle. Education will become more interspersed and interwoven with work, and more spread out over a lifetime.

The changes that lie ahead are the consequences of conflict, not automatic progression. The responsibility for change lies with us.

We must teach ourselves not to close our minds prematurely to the novel, the surprising, or the seemingly radical.

WORDS FOR SALE

Diane Husmann

Have a classroom market with words as the commodity. The children find the price for the words by adding the value of each letter in the word. (The minimum acceptible word length would depend on the grade level.) The child must give the correct value for the word in order to "buy" it. The chart gives the value of each letter.

1	2	3	4	5
A	B	C	D	E
F	G	H	I	J
K	L	M	N	O
P	Q	R	S	T
U	V	W	Y	Z

VARIATIONS:

1. Each child could keep a notebook of valuable words. The child must be able to use the word in a meaningful sentence before he/she can enter it in the notebook.
2. A word hunt game. You could have a container with words in it. The child would pick a word out of the container. He must be able to use the word in a meaningful sentence and give the value for that word before he can have it.
3. For older children a word hunt game similar to "scrabble" might be a good idea.

(This idea grew from my reading Seedling 1)

DISCOVERING THE TENS PLACE

Jo Ann Williams

Eight sixth grade remedial math students were asked to do a series of tasks. The students varied in age from eleven to twelve years old. Of these tasks three were chosen to be described in this paper. The three tasks consist of:

1. Counting forward by ten starting at thirty-four.
2. Reading the numbers 342, 243, 432.
    a. Extended by: "What does 3 stand for in each?"
    b. Write the number that is 1 more than 342.
    c. Write the number that is 10 more than 243.
3. Computation of an addition alogrithm

$$\begin{array}{r} 37 \\ +28 \end{array}$$

Extended by:

a. Tell me how you worked it out?

b. What does the "1" stand for?

These three tasks were chosen because they related closely to and represented how the eight sixth graders perceived the ten's place. They all were able to do the textbook alogrithm 37 + 28. Yet explaining the tens place was not possible for over half of them in two of the tasks and almost half in one.

Individual interview observations were conducted using a tape recorder and observer taking notes on what could not be heard.

RESULTS	NOT ABLE	ABLE
Count forward by tens starting at 34	75%	25%
Read these numbers: 342, 243, 432	--	100%
What does 3 stand for in each	--	100%
Write the number that is 1 more than 432	12.5%	87.5%
Write the number that is 10 more than 243	25%	75%
Computation of an addition alogrithm		
37 + 28	--	100%
Extensions:		
Tell me how you worked it out?	--	100% (Using "1" as describing what they carried.)
What does the "1" stand for	62.5%	37.5%

These were shocking results considering they were sixth graders ranging from ages eleven to thirteen even though they qualified for a remediation program. All the students that could not count forward (task 1) were given extension activities before going on to reading numbers (tasks 2, 2a, 2b, 2c). These activities were such that the students had the opportunity to discover how to accomplish counting by tens starting from 34. (My instinct to teach took over here.) For example, the students were given popsicle sticks that were in groups of tens and loose ones. These students were encouraged to use the sticks in any way they wanted to help them count forward by tens from 34. Half of the students did discover this and of these one said he had never worked with manipulatives.

Students that could not count forward (task 1) said 34 was not a ten number. Therefore you could not count by tens or something to that effect. These students did not discover with the manipulatives to count forward by ten from thirty-four. The students that did discover task 1 also extended themselves to other numbers (counting by ten from 36 for example number relationships were discovered by the students when asked "What's Happening?" They said the ones stayed the same, but the tens and hundred change.

It appears that the students having this opportunity to discover their own way of counting tens from 34 could have had a positive bearing on the extensions of the second task when asked to write one more and ten more. (2b, 2c).

In task 2 (reading numbers) and the extension 2a (what does the three stand for) the students responses appear to be the result of textbook presentation and memorization rather than real learning. For example, the student that stated it was impossible to count by ten from 34 could not count accurately from 199. (Another task documented at end of paper). This student as well as all the rest of the students were able to answer "What does 3 stand for in each?" Yet over a third of the students could not write the number that was one more or ten more (2b, 2c).

For task 3 (The textbook alogrithm) 100% of the students computed accurately. They all explained their computation using "1" when describing what they carried. Over half of these students responded that the "1" stood for one not ten. These students stayed with this explanation even when showed one group of ten sticks and one stick.

Having students perform problem solving tasks while observing with minimal interruptions prove to be a valuable diagnostic tool for teachers.

The students errors give information as to where the student is in his understanding of various concepts. Specifically these students' performance of the three tasks described show a wide variation in students' understanding of tens place. Some are in desperate need cf counting experiences with manipulatives before they will be ready to proceed to tasks that will help them discover place value. Others are on their way to discovering place value even past tens. The following documentation of tasks required of this group will be helpful in planning individual curriculums. These interview observations will be used throughout the school year in the remedial math program.

Eight sixth graders eleven tasks classified:

	% Responded
1. Count forward by tens starting at thirty-four	
a. 34, 44, 54, 64, ...234	25%
b. 34 is not a ten's number so can't do it; has to have a zero; 40, 50, . . . 100; 34 not a ten number.	37.5%
c. 34, 44, 54, ... 104, 108, stopped	12.5%
d. 34, 44, 54, . . . 104, 134, 144 . .194 stopped	12.5%
e. 34, 44, 54, . . . 104, 112, 124, stopped	12.5%
2. Read these numbers: 342; 243 ; 432	
a. Three hundred forty two	100%
Two hundred forty three	100%
Four hundred thirty two	100%
2.1 What does the three stand for in each?	
a. third place, first, second or etc.	100%
2.2 Write the number that is one more than 342.	
a. wrote $\begin{array}{r}342\\ \underline{1}\\ 343\end{array}$ $\begin{array}{r}243\\ \underline{10}\\ 253\end{array}$	12.5%
b. 343 253	62.5%
c. 345 254	12.5%
d. 342 254	12.5%
3. Computation addition alogrithm $\begin{array}{r}37\\ \underline{+28}\end{array}$	
a. $\begin{array}{r}1\\ 37\\ \underline{+28}\\ 65\end{array}$	100%

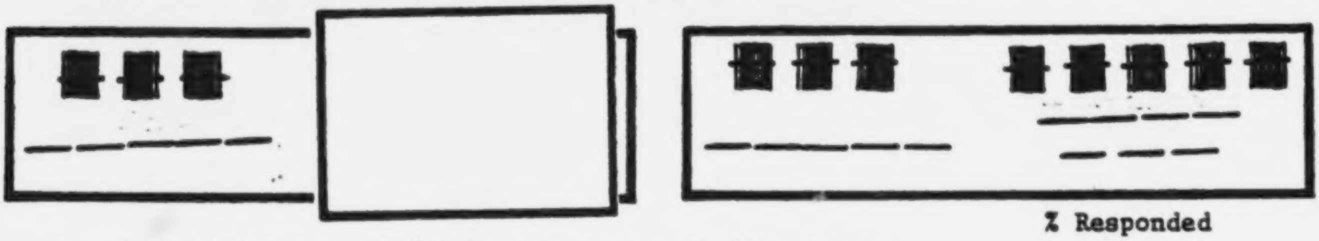
	% Responded
3. cont.	
3.1 Tell me how you worked it out?	
a. Eight and seven is fifteen or seven and seven is fourteen and one more for fifteen - Put five down carried one added one to three and two to get six.	100%
3.2 What does the "1" stand for?	
a. "1" stands for one or is in ones place (even later when looking at one group of ten sticks and one stick.)	62.5%
b. "1" stands for ten	37.5%
4. Count forward by ones from one hundred seventy seven.	
a. 177, 178, 179, ... 199, 1000	12.5%
b. 177, 178, 179, ... 230	87.5%
5. Count forward by tens.	
a. 10, 20, 30, ... 190, 1000	12.5%
b. 10, 20, 30, ... 990, 1000	87.5%
6. Read 231; 198	
a. Two hundred thirty one One hundred ninety eight	100%
6.1. Which is larger?	
a. Two hundred thirty one	100%
6.2. How did you decide?	
a. Because two is in hundreds spot or two hundred is more than one hundred tens and ones don't matter when there's hundreds and two is bigger than one	100%
7. Write the following numbers:	
7.1. Seventeen	
a. 17	100%
7.2. Seventy-one	
a. 71	100%

7.3.	Ten and two (Any other ways?)	% Responded
a.	10 2 (First response for 62.5%)	62.5%
b.	102 (First response for 25%)	50%
c.	10 + 2 (First response for 12.5%)	25%
d.	10 and 2	25%
e.	12	37.5%
f.	20	25%
g.	10 X 2	12.5%
h.	10^2	12.5%
i.	10 10	12.5%
j.	2222222222	12.5%
k.	2 2 2 2 2 2 2 2 2 2	12.5%
7.4.	Two hundred eighty-nine	
a.	289	100%
8.	Read these numbers:	
8.1.	204	
a.	Two hundred four	100%
8.2.	5,617	
a.	Five thousand six hundred seventeen	87.5%
b.	Five million six hundred seventeen	12.5%
8.3.	8,012	
a.	Eight thousand twelve	87.5%

		% Responded
b.	Eight million one hundred two	12.5%
8.4.	140,770	
a.	One hundred forty thousand seven hundred seventy	25%
b.	One thousand forty - started over One hundred thousand - started over again One hundred forty thousand seven hundred seventy	12.5%
c.	Counted ones, tens, hundreds, thousands, ten thousands - Can I add it? (Do you want to?) Oh! that wouldn't help. Oh! One hundred forty thousand seven hundred seven.	12.5%
d.	One thousand forty seven a hundred seventy	12.5%
e.	One hundred ten thousand - started over One hundred thousand and four hundred thousand and forty seven hundred seventy	12.5%
f.	I don't know	25%
8.5.	1,020,004	
a.	One million twenty thousand four	37.5%
b.	One million two thousand four	12.5%
c.	Counted places compared number of places with previous number - One Billion twenty thousand four	12.5%
d.	I don't know	37.5%
9.	Write these numbers:	
9.1.	Six hundred seven	
a.	607	100%
9.2.	Two thousand five hundred fifteen	
a.	2,515	100%
b.	2,500 (corrected self) 2,515	12.5%
9.3.	Six thousand eleven	
a.	6,011	100%
9.4.	Three hundred sixty thousand four hundred forty	
a.	360,440 (One could not read it back)	50%
b.	3,040	12.5%

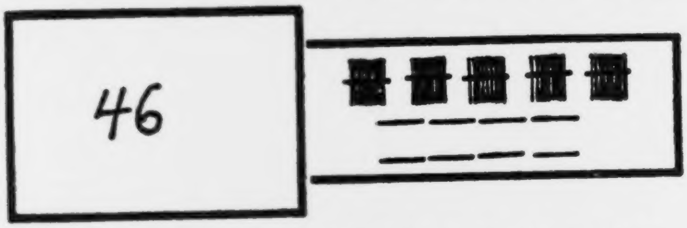
	% Responded
c. 300,060,440 (after read back, corrected to 360,440)	12.5%
d. 36,440 (read back as seen here but corrected to 360,440)	12.5%
e. I don't know	12.5%
9.5. Eight million eighty thousand eight	
a. 8,080,008	37.5%
b. 880,008	12.5%
c. 8, . . . 8,000,008	12.5%
d. 8,80,008 (spontaneously went back to put a 0 in) 8,080,008	12.5%
e. I don't know	25%

10. Counting objects: Count the number of sticks showing. There are more sticks under the paper. As I uncover them, count to find the number of sticks altogether on the table.



	% Responded
a. Counted by tens to 70 then grouped ones into a ten, then counted two. 82.	12.5%
b. 10, 20, 30, . . . 70, 71, 72, . . . 82.	12.5%
c. 10, 20, 30, . . . 70, counted 1, 2, . . . 12. Then said 70 and 12 is 82.	25%
d. 10, 20, 30, 31, 32, . . . 35. Then started over and counted 10, 20, . . . 70, 71, 72, . . . 82.	12.5%
e. 10, 20, 30, . . . 70. Said 5 + 7 = 12. Said 182, then started over - moved the sticks - counted 10, 20, . . . 70, grouped ones into 10 then said 80, 81, 82.	12.5%
f. 10, 20, 30, . . . 70, then for ones 80, 90, 100, 101, 102, . . . 109.	12.5%
g. 10, 20, 30, . . . 60, then ones 61, 62, . . . 71, then picked up other ten and said 81.	12.5%

11. Counting objects: There are forty-six sticks under the paper. Count on to find out how many sticks there are on the table altogether.



% Responded

a. 46, 56, 76, 86, 96, then stopped - put 6 in 46 with 4 ones for 10 to make 50 then 60, 70, . . . 100, 101, . . . 104.

4 ones with 46 makes 50 then 60, 70, . . . 100, 104. 25%

b. 46, 47, 48, 49, 50, . . . 115. (counted each one in tens) 12.5%

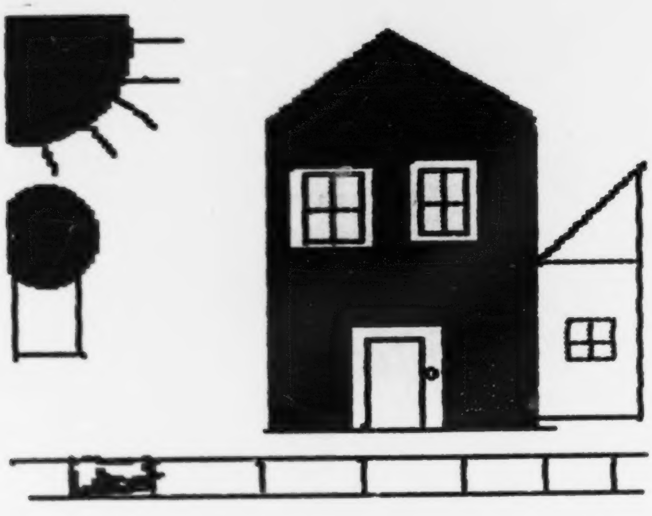
c. 46, 56, 66, . . . 96, 97, 98, . . . 104. 12.5%

d. 46, 56, . . stopped counting . . 40, 50, . . . 90, 96, 97, . . . 104.

40, 50, . . . 90, 91, . . . 98 and 6 is 104.

40, 50, . . . 90, 1, 2, . . . 14. 19 + 14 = 104. 12.5%

e. Wrote alogrithm in air and said 104 - wanted to check with sticks uncovered and counted 10, 20, 30, . . . 90, 100, 101, . . . 113 - I asked which he liked the best - said 113. 12.5%



Chris Edwards and Kurt Wohldmann, Ages 11

REGROUPING WITH A TWIST

Cindy Fox

At a Teacher's Center Project session recently, Dr. O'Brien showed us a different way to teach subtraction of two or more digit numbers. Sometimes two or more digit numbers are hard to subtract since the top number is smaller than the bottom number, such as twenty-four minus sixteen. One way to eliminate this problem is to add four to each number so that twenty-four becomes twenty-eight and sixteen becomes twenty. Twenty-eight minus twenty equals eight and twenty-four minus sixteen equals eight. Theoretically you have not changed the numbers at all. You do not have to add four, any number that increases the top number so that it becomes larger than the bottom number will work.

```
 24   28
-16   20
---   --
  8    8
```

It works fabulously, I tried it with my second graders and they loved it. Some of the children were having a lot of trouble with regrouping and this method really helped them.

Another way to help them is to subtract the bottom number from the top tens column and all the left over ones, then subtract the bottom tens from the top tens that are left. Such as eighty-three minus twenty-six, take six ones from one of the top tens. The top number becomes seventy-four and you can then add four and three and subtract two from eight. This one did not go over as well with my second graders but I think it would probably help older children who were having more trouble.

```
 74
 83
-26
---
 57
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NON-NUMBER PROBLEM SOLVING

Mary Ann Toenjes

A lot of children in our schools have math anxiety. Many times this stems from one of two things -- they are lacking in computation ability or they have not yet developed the ability to think logically. Since computation has its foundation in logic, the emphasis must be on logical thinking to combat these fears. Taking the numbers out of problems is a way to promote this logical thinking without a negative reaction from math-anxious students.

The purpose of each of the following activities is the development of logical thinking and problem solving strategies. They range in difficulty from the primary level to the junior high school level. Rather than computing an answer, students will be challenged to solve the problem (There IS a difference!)

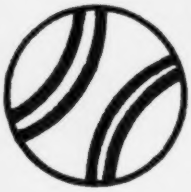
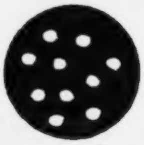
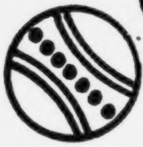
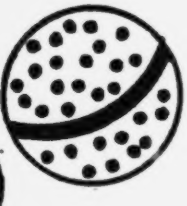
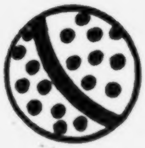
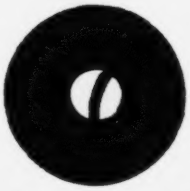
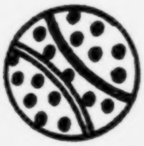
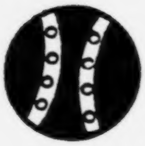
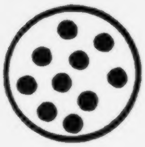
Problems such as these may be designed by the teacher at first. However, when the student is able to successfully find strategies for solving these, he/she may be further challenged to create his/her own non-number problems. These can then be exchanged among the other students.

ACTIVITY 1

Garrick has finally saved enough money to buy a ball that he had seen in the dime store. Garrick couldn't reach the ball so he described the one he wanted to the sales clerk.

1. It is a ball with black spots.
2. It is a white ball with black spots.
3. It is a big ball.
4. The ball has a stripe around its middle.

Which one did Garrick buy?

ACTIVITY 2

Patti, Chris and Jamie won prizes for a spelling contest. Each prize was a storybook about a different animal. Can you decide which child won first place, second place and third place and what their prizes were?

1. The cat story was the third prize.
2. Jamie was glad he didn't win the story about the dogs.
3. Patti stayed in the contest longer than Chris.
4. The horse story was the first place prize.
5. Jamie could spell more words than Patti.

PLACE	1st	2nd	3rd
NAME			
ANIMAL STORY			

ACTIVITY 3

Each of the Jones' children have a favorite snack and a favorite drink. Mrs. Jones is confused. Read the clues and help Mrs. Jones decide what each of her children likes.

1. The person who likes Kool-Aid also likes pretzels.

2. Kim loves chocolate chip cookies.
3. Nathan's favorite drink is not soda.
4. Sally would rather not have Kool-Aid.
5. The person who likes potato chips does not choose orange juice as the favorite drink.
6. John is crazy about milk.
7. Soda and ice cream are one person's favorite foods.
8. One of the boys thinks potato chips are the greatest.

NAME				
DRINK				
SNACK				

ACTIVITY 4

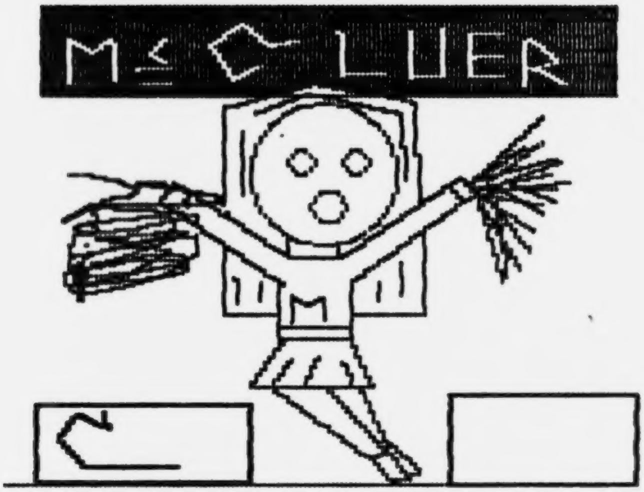
Six schools were entered in the track meet. The team members of each school wore their school colors. Read the clues and figure out each school's color and the position they finished in the race.

1. The first and fourth placed teams wore shades of blue.
2. Compton School lost the race.
3. Lincoln School always loses to the royal blue team by a hair.
4. Grant School had on maroon uniforms.
5. No one came in after the team who wore kelly green.
6. The scarlet team came in between Holiday School and Grant School.
7. Lincoln School came in before Compton but just after Bunker Hill School.

8. Washington did not wear gold uniforms.

9. The team with the sky blue uniforms has always beaten Washington School.

PLACE	1st	2nd	3rd	4th	5th	6th
SCHOOL NAME						
SCHOOL COLOR						



Betsey Tucker, Age 11

PILGRIMS

Carolyn A. Dujka

I asked the children to write a short paragraph telling me what a pilgrim is. In the course of walking around the class, one girl stopped me and asked me how her paper looked. Within her paragraph I found the sentence, "And some of them were small." This sentence was surprising. The children in the class are fifth graders. I asked her to show me how tall a pilgrim is. She was rather shy and hesitated. I asked her again, but this time I held my hands about 16 inches apart and said, "This small?" She giggled. I asked her to show me. Finally she held her hand at about waist high from the floor. Several of the boys laughed at her and said that pilgrims were regular sized. She asked if she was right and then said, "But some of them were small."

After this interesting discovery I decided to get a class consensus. I stepped to the front of the class and asked them how tall pilgrims were. They jumped out of their seats to show me that pilgrims were as tall as they were, or onto their chairs to denote more height. But, the most interesting discovery came when more than half of the class held their hands at waist height! After peer pressure, the short pilgrim promoters hesitantly lifted their hands from waist height. They did not believe pilgrims were really full height. One of the best students came to me and said, "I know pilgrims came over on the Mayflower and Thanksgiving and all that, but isn't pilgrim another word for small?"

A LETTER TO DAVID

Helen L. Miller

Some time ago a British friend, David Wells, asked me to describe the status of problem solving as it occurs in local schools. I asked a number of Teachers' Center oldcomers to respond to the issue as well. Here is Helen Miller's reply to David. -- Tom O'Brien

Dear David,

I would like to share a few of my personal observations with you about "What is actually happening in the classrooms - in elementary schools." I teach in a typical elementary school in the Midwest. The educational methods espoused by the teachers with whom I work are representative of those in most areas of the country.

Most of the teachers feel obligated to follow the maths textbook adopted as the required material to be taught in all the schools in a district. Most of maths series emphasize computational skills and require rote learning of arithmetical facts. At the primary level some texts suggest manipulative activities, but the accompanying workbook pages give children exercises in doing arithmetical problems.

The teachers who are concerned about the developmentally inappropriate material and about the need for children to understand what they are doing are thwarted by an educational system which requires standardized tests for everything! Educators, as well as the public, demand exit level tests that demonstrate a student's ability to compute numbers satisfactorily and advocate competency tests that will evaluate a student's acquistion of the "facts" that he was taught. Many teachers would like to help children learn, but few have the time to do both - to help children learn and to provide them with the skills they will need to pass the standardized tests.

It is much easier to follow the teacher's guide and to adhere to the traditional methods of teaching arithmetical skills than to attempt to do what is not encouraged by most principals and misunderstood by the general public whose tax dollars pay a teacher's salary.

Education has become a big business in this country. There are still many who feel that the production-line system of learning must be adhered to. The raw material is put into the machine; it is molded and shaped; the material is processed; the product that is turned out is tested; if it successfully passes the test, it is sent on to the market place.

A college professor who teaches art in this area was lamenting the fact that college freshmen were able to paint nothing other than dog's heads. They had been taught the techniques and how to use the tools that an artist must know. They were proficient at turning out a product - dog's heads. They had no understanding of art itself! They had never had the opportunity to learn about the asthetic qualities, the emotional values, the composition of a painting, the essential, basic meaning of art. Dog's heads - the product - was the prime concern of the elementary and the high school teachers.

There are a few of us who are trying to teach children, rather than teach the subject, and who feel very strongly that children will learn if they can understand what they are doing. In my building there are two of us who openly profess to be constructivists and who feel that maths is not rote learning of arithmetical facts. Two out of twenty-five teachers is a rather high percentage for one building.

One or two others are actively searching for a better way to help children learn. Because many teachers have thirty-five to forty children in their classes they feel that complying with the district requirements is the only feasible way to manage a group that large. Some teach in the traditionalist manner because they cannot conceive of doing anything else.

Two weeks ago I was a speaker at the annual conference of the Illinois Council of Teachers of Mathematics at Illinois State University in Bloomington, Illinois. I was astonished and delighted by the enthusiasm and the interest teachers from all over the state exhibited for the ideas about learning that I shared with them. These ideas included many activities which were developed to help children solve problems and understand quantitative concepts, patterns, numerical relationships, and classification skills.

The publishing companies which had exhibits at this maths conference were showing many books which dealt with creative thinking and with "problem solving". Participants seemed to be more interested in manipulative materials this year than I had seen in previous years.

Things will change because a few of us are sharing what we have done with others. Things will change because many teachers intuitively know that arithmetical skills are not what the children will need to know in the next century. We have produced enough dog's heads to last an eternity; it is time for understanding to become the goal of education!

I hope this has been of some help to you. Good luck with your project.

Helen

LUNCH COUNT MATH

Judy Koch

Every week two of my second graders take the lunch count for the whole class. This takes about 10 minutes and has been a very valuable experience for the children in using math in a practical everyday situation.

At first, I just asked the children to count the number of children who would be buying their lunches. As time went on, the children have developed other ways to do this.

1. Sometimes they still count by ones.
2. Sometimes they count by twos.
3. Sometimes they count the children in each working group and then add the group counts together (column addition).
4. Sometimes they count each half of the room and then add the two counts together.

After every child had had experiences with one of these methods, I asked if anyone could come up with a different way of taking the lunch count. One child suggested we could count the number of children not buying their lunches and subtract that number from the number of children present. Someone else was quick to point out that the number of children present each day is another subtraction problem -- the number of children in the class minus the number absent. Still another child said they didn't really have to subtract, they could just count back to get the same answer.

The counters for the week decide which method they'll use on any given day. Sometimes they use more than one method as a check.

We did encounter a few problems -- sometimes we'd hear a voice in back behind the cabinets or someone behind a bookshelf or walking to the bathroom saying, "Count me. I'm standing." Or maybe someone would come late after the count had been taken. It was fun and the children were learning problem solving in a real world setting where things aren't always neat and tidy and children don't always stay in one place and numbers aren't written in neat columns accompanied by operation symbols.

CONSERVATION?

Cheryl Miller

Three people were having lunch one day. Two were four years and ten months old girls and the other was an adult. They had decided that they all wanted bananas for dessert, but there was only one banana to be shared among the three people. The children decided that the banana should be cut into six pieces. Next they deliberated on how to divide the six pieces among the three people. The girls decided that everybody should take one and then another piece. One girl, Carey, said, "You got more than I did." The adult asked, "How many do you have?" Carey; "One, two." Adult; "How many does Christy have?" Carey; "One, two." Adult; "And I?" Carey; "One, two." With a small look of surprise, she said rather quietly, "Oh. Well, I'll cut mine up to make more." When she finished she said, "See, I have more now." Christy looked at hers and then at Carey's with a quizzical look and then proceeded to cut up hers. "Yeah, I have more, too!"

CHILDREN'S THINKING PROCESSES IN MATH

Nell Yount

The group of tasks I used for this child watching experience arose from a simple task derived for a child in an in-class testing situation. The child mastered the original task so easily I expanded it extemporaneously to harder tasks. Since I wished to use this study as a base for an activity center in my classroom, I chose materials available to me -- one of three math manipulatives in my room -- a box of colored one inch cubes -- fifty of them. Using a grease marker or a permanent marker I placed one digit on one face of each block. (Putting numbers on all faces might cause a number to accidentally be changed during testing by rolling over.)

When each child reported to the testing center I had a line of six blocks set out, the number being 342,765. After explaining to the child that I was not testing him for a grade, but to see how he thought, and that I would not tell him if he was right or wrong, I also explained that I would use this information to help me do a better job of teaching the math he needed to learn. Then I asked the following questions.

1. Would you please read this number to me?
2. Can you move only one block and make this number larger than the one you just read?
3. Are you happy with the number you have made? Read it.
4. Move as many blocks as you wish and make the largest possible number of six digits. Are you happy with the number you have made? Why did you place them in that order? Read the number.

5. You can trade 1, 2, or all the blocks for any of the other blocks still in the box. Make the largest possible number you can with just six digits. Are you happy with your number? Why did you choose that number? Read it.
6. Here is a block with the number 1 on it. Place it anywhere in the row, or in front of the row or at the end of the row and make the biggest 7 digit number you can from these same blocks. Are you happy with this number? Why did you place the one where you did? Read the number.

All ten students managed to read the number presented, though all but three had to start over from two to five times, stopping themselves and saying, "No, wait, that can't be" -- "that's not right" -- etc., until the right answer was given. The most common error was to start out with 3 thousand, then realize there were more digits left than they had places, and so start over until they filled all name calling spaces. Two students separated the blocks into two groups of threes before they could find the proper number name. Three children went through the place value steps beginning with the ones space to determine the proper number.

Conclusion: Most fourth grade students in this school can read a 6 digit number, but the majority will require several tries to do so. They are lacking in the concept of hundreds, tens, ones in each grouping of three or are confused as to the series names of ones, thousands, millions, etc. Most have the basic facts, but are not completely comfortable with them yet.

Questions 2 and 3: All students succeeded in moving a block to make a larger number. Half the students replaced a block in the first

3 digits, while half replaced blocks in the last 3 digits. Three of the five replacing a block in the first series of digits moved the 7 (largest number available) to the frontal position. Seven of the children picked up 2 or more blocks before making their final choice. Only 3 made automatic unhesitant choices of the block to choose. Three children were happy with wrong answers until asked if they were happy with it and to read it, at which time they corrected their error.

Conclusion: Most fourth grade students have the knowledge that digits coming first in a number are worth more. I am uncertain as to whether their hesitancy was not knowing which to choose to accomplish the task, or trying to second guess whether I had one particular block in mind to be moved (as many asked -- "This one?" -- "Does it matter to you which one I choose?" -- or even attempting to make the biggest number possible in one move. Verbalizing helped the children evaluate and assess their own work and see their own mistakes and make their own corrections. Saying the number seemed to help them evaluate its worth.

Question 4: All the children succeeded in arranging the 6 blocks sequentially into the largest possible number 765,432 before they were asked if they were happy with that number. This was surprising since it was a harder task than the previous one where three children at first made mistakes. Perhaps the activity done just previously helped to organize their thinking. Three took several tries before stopping and letting me know they were finished. One student arranged the blocks, had a wrong answer, read the number aloud on his own, repeated it again, then rearranged to a right answer. When asked why they used this arrangement, five responded with statements centering around the fact that the numbers worth the most come first, so the bigger numbers should be put there to get the biggest possible number. One responded that each digit (they said number) is worth 10 times the one after it, so the biggest digits should be placed where they would be worth the most.

Conclusion: Most fourth grade students in this school recognize the greater value of numbers from left to right positions, but may not have the clear understanding as to why. Some gave answers such as "That's the way it has to be" or "It looks bigger that way because you see the biggest numbers first!" The ease with which arrangements were made did not necessarily correlate with the best reasons for the arrangement.

Question 5: With this question I began to see greater hesitancy and more looking to me for hints. In trying to trade for the largest possible six digit number, six of the children arranged, rearranged, studied, placed and replaced many blocks in many patterns before finishing their manipulation of the blocks. Seven asked me if they could replace all blocks or if the blocks could all be the same even though this had already been stated in the directions. After all trials, when all were finished, 7 arranged 999,999, two children arranged 876,543 -- one digit greater in each place than the original number -- and one child arranged 987,654. These last 3 children stuck with their answers when asked if they were happy with them, and after verbalizing them. I wonder if the previous task of arranging in sequential order stayed on the minds of these last three like a ghost image on a TV screen and flavored their thinking on this task. It might be a good idea to repeat the task without the previous question and see what results I get from the same children.

Conclusion: Fourth grade children in this school are weak in their concept of 9 being the largest digit that can occupy any place in a number as it is normally written. The child who went one bigger in each place reminded me of the child in Ed Labinowicz's study who did the same thing in a different context.

Question 6: Here more variance was shown in both decision making time and in placement. Four children placed the number in front of the previous array. Two of these then showed 1,999,999, while one made 1,987,654 and one showed 1,765,432. The other six responded correctly, 3 with some hesitation, 3 instantaneously. All were happy with their answers of 9,999,991. All could read their answers, though six used false starts.

Conclusion: When moving into numbers beyond 6 digits, children have greater difficulty determining larger numbers. This uncertainty may cause even a student who has demonstrated understanding of place value with six digits to become confused. Even students who had previously unhesitatingly made larger numbers and largest numbers experienced problems, and saw no inconsistency in 1,765,432 arrangement. Four students who placed the one in the frontal position replied to the why question with answers such as "cause that's a million". Others responded with answers such as "one is the smallest digit, so it needs to go at the end to keep the number the biggest." Some had no answer.

General conclusions: Due to consistent and repetitious teaching concerning place value from first grade on, students in this school's fourth grades have some understanding of place value to the sixth place, but becomes more confused as the number moves in the millions. However, this knowledge is not always consistent or explainable.

Thinking in these terms seems to be hard for most of the students.

Verbalizing seems to help clarify the comparison of numbers for children.

Most children will be content with the product of the end of their series of endeavors, and will not tend to review and to reevaluate after one final answer is reached unless some stimulus -- in this case "Are you happy with your answer?" -- is applied.

All the children expressed pleasure at this "game" and the box of blocks has become a favorite 'stretching my mind time' activity.

ESTIMATION

Pat Potthast

Have children estimate number of beans (or beads or grains of rice) in various sized jars.

Have them estimate number of beans in a Pringle can by shaking it and estimating by sound. Do this with various amounts in different sized cans.

After estimation, then count.

UNDERSTANDINGS OF MATH

Betty Thompson

Introduction

The purpose of this study was to see how well beginning third-graders understand place value, subtraction with re-grouping, identify four coins and count the value of coins.

Eight students were interviewed with only the interviewer and the student present. This was done outside their home usually on the front porch swing or on the front steps. All seemed to feel at ease in this setting.

The Study

Each student was asked to read: 203, 76, 713, and 516. They were asked how many tens were in 76, and what the 6 meant in 516.

Then they were given a sheet of paper with the subtraction problem 43 - 17 = ?. After the student worked the problem they were given beans and a ten sticks and asked to show what they did.

The last part of the check was to ask the student to count to 100 by fives and to 1000 by tens. Then they were shown a quarter, a dime, a nickel, and a penny and asked to name each coin. After they named the coins they were asked how much money was there in all.

Six of the eight could read correctly: 203, 76, 713, and 516. The other two missed 713 (naming it seventy-three) and 516 (naming it five hundred six).

When asked how many tens are in 76, only three of the eight answered correctly. Three didn't know and the other two answered, "seventy tens?" and "three tens".

Out of the eight only one could tell that the six in 716 stood for six ones. Four said they didn't know, the other two answered 16 and one simply said, "tens".

From these three tasks I would have to conclude that most did not understand place value. The next task confirmed this conclusion.

43 - 17 = ? was written on a paper and handed to each student for them to solve. None of the eight solved it correctly. Six answered "34", while the other two didn't attempt it. Beans and a ten-sticks were then provided and they were asked to show how to solve it. With these manipulatives four were able to get the correct answer of 26, however one of these students chose the other answer (34) as the best answer. After questioning them only one student said she borrowed a ten. Three of the four corrected the written problem.

The next task was to count to 100 by fives. All eight completed this successfully. Counting by tens to 1,000 was quite different -- only two did this correctly. The others ran into difficulty after 100. One counted correctly to 200 and then finished by counting hundreds (300, 400, 500, 600, 700, 800, 900 ten hundred, oh, I mean 1,000). Most would get to 100 and then change the pattern -- instead of tens they counted by hundreds. One said 190, 1,000. Clearly for six out of the eight there was little understanding after they reached 100.

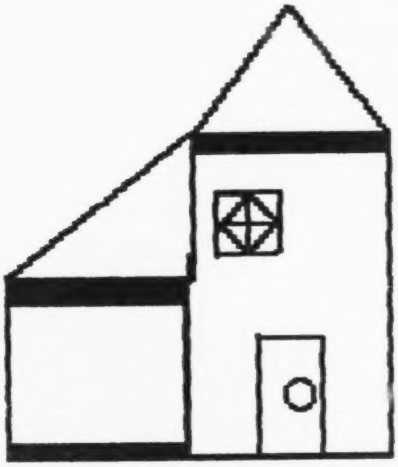
In the final task of naming coins all eight students could name a quarter, a dime, a nickel and a penny. Although the value of each coin was not asked, they apparently knew this. Six of the eight counted correctly and gave $.41 as the answer. All six of these started with the quarter (25¢) and ended with the penny (1¢). Brian gave the nickel as much value as the quarter: (quarter) 25¢, (nickel) 50¢, (dime) 65¢, (penny) 66¢."

Cheryl gave the dime and the nickel the same value: "(quarter) 25¢, (dime) 35¢, (nickel) 45¢, (penny) 46¢."

Conclusions

It is clear from my observations that more counting activities are needed. Working with manipulatives will facilitate a better understanding of place value than the pencil and paper exercises most students are asked to complete. These children demonstrated a lack of ability to relate the knowledge they had and build on it in the subtraction exercise. (Logically their answers couldn't be correct if they understood counting by ten. Thirty-four is not even ten less than forty-three and they were subtracting seventeen from forty-three.)

The fact that they were more successful with the money questions further emphasizes that working with manipulatives creates a better understanding of some concepts. Most had handled coins in making purchases. The two that weren't successful in counting the correct amount of money, said, "Mother usually pays for my things."



Dana Walberg, Age 11

TO MIMIC OR TO UNDERSTAND

Jill Allaria

As a teacher I have found that we often teach children to mimic, rather than teach them to solve new and different problems. We often teach children only one way of doing a problem instead of letting them find a way to solve a problem. Children can do problems or mimic, but do not really know why they are doing things. Instead of directing learning towards understanding in the schools, teachers often only work at getting stereotyped responses. Just because children can do certain paper-pencil type activities does not mean they understand them; they have often just memorized what to do.

For example, I found out children often have no idea what an equal sign means, even though they do workbook pages every day with equal signs on them. I gave fourth graders a problem such as 2 + 4 = + 3. Most of the students in the class immediately answered 6, because they said 2 + 4 = 6. They completely ignored the + 3 at the end. When I reminded them of the + 3 at the end, the next responses were 9. They had added all the numbers. Next some students said 5, because 2 + 3 = 5. After I told them to try again, a lot of them just gave up and started guessing any number. Finally someone guessed that 3 was the right answer, but didn't know why, and then another student figured out that 3 was right because 3 + 3 = 6 and so does 2 + 4. Only one student in a class of 20 knew what the equal sign meant, but all of them had worked pages with equal signs since first grade.

Another example of children memorizing with no understanding that I found was in multiplication problems. Most of the children by fourth grade have memorized their multiplication facts. I asked the students to make up a word problem for the equation 7 x 2 = 14. This is what I got. "If Bill has 2 apples and John has 7, how many do they have in all?" NO ONE could come up with a problem which actually meant 7 x 2 = 14.

WHERE DOES IT BELONG?

Margaret Moffatt

Because I work with children who have language problems, I use lots of classification and categorization games. This game is played a bit like Concentration.

The children are each given a large card which has a picture of a room on it. Small cards, which have pictures of furniture, toys, tools, etc., on them are placed face down on the table. The first person turns over a small card and identifies the picture. (For example, a frying pan.) If the picture is something that belongs in his room picture, he keeps the card. If not, he turns it back over on the table.

This game could be played with other categories, such as house pets, zoo animals and farm animals; land vehicles, water vehicles and air vehicles; things we see, things we smell and things we hear, etc.

Editors Note: How about using a doll house and miniatures for this activity?

A METAMORPHOSIS IN A CLASSROOM

Judy Barnett

At an extremely hard time in my life, I was exposed to an experience that I will call a metamorphosis in a classroom. The classroom was an 8th grade study hall in a junior high school. I was a substitute teacher and started shortly after the school year had begun. You judge for yourself what caused this change.

I was a full-time teacher of 10 years without a position because of a reduction in force. I received an opportunity to substitute for a physical education teacher for approximately four months and one of my duties was an 8th grade study hall, three class periods a week. The students in this study hall were considered "not so bright", "dummies", "a bunch of losers", "the unchosen ones", "trouble makers" and other such labels. They were in there because they had not taken band or chorus and they were not chosen as library aides, hall monitors or office workers.

The study hall was run in a very strict manner where the teacher was commander-in-chief. The rules were: sit in your seat, study, read or sleep. Nothing else. You were not to communicate with classmates in any way, wiggle, turn around in your seat, or tap on your desk. Punishment for those who didn't follow these rules was harsh and lengthy verbal chastisement. I witnessed one boy receiving this kind of treatment for tapping on his desk. The students had a strong dislike, to put it mildly, for the study hall and for the teacher.

I entered this class prepared to enforce these set rules but I was plagued with a major problem. I was taking a night college class and one of my assignments was to observe students doing math activities and games. Wow, I had little or no time to do this! Nothing lost if things went badly, I decided to see if I could interest these students in helping me. I presented my request in the form of, "Is anyone willing to help me with my homework?" The first response was two or three students who pulled their desks around mine to play different kinds of math games. It wasn't long until our group grew to five or six "regulars". As weeks passed we had as many as ten to twelve students participating regularly. They would meet me at the door with statements like, "Do you have any new games today?" or "Can we continue the one we were playing last time?" or "I tried that game on my family at home last night".

The students were stunned when I told them there was no such thing as a wrong answer in what we were doing and stunned by the fact that I was more interested in how they found the answer than the answer itself. They had trouble adjusting to finding other ways to solve the same problem. (They saw no need, if the first method worked.) The idea of working together in groups was considered cheating. They overcame these feelings as we continued to work together.

We played games such as; "Likes-Dislikes" (see Vito Benivegna's article), the "H Game" (introduced by A. I. Weinzweig and written up in an earlier SEEDBED by Mary Steffen), "The Hidden Chip Task", "Guess Who or What" with yes or no questions and many others. The students discovered that there were many ways to solve the same problem, there was a neat feeling in making a discovery on your own or in a group, and that a group can be very helpful with certain tougher problems.

We progressed from students always wanting to be "it" or having their turn, to paying attention to how someone solved a problem. We found ways to go on when stuck and ways to make the tasks tougher and more fun. We changed rules of some games to make them more challenging.

Our feelings toward each other changed. We knew more about each other than we had before and had an appreciation for each other's intelligence. Some even recognized some intelligence in themselves. Statements like, "I'm not so dumb after all!" or "I really did get a right answer to that problem, didn't I?" or "I found a way no one else did!" were not uncommon. I realized that I had no discipline problems any more and that I felt a new warmth toward these students. I knew more about them and their different levels of mental development than I ever had before with any of my previous students.

With my night class time coming to an end, I talked to this group of students and I told them that I was going to write about them. They were pleased and when I asked them to verbalize what had happened in our study hall, I got these responses, "It's fun", "I like it now". My favorite was "It's like an elementary recess", followed by another girl's "But we really have learned".

You decide what caused this change, you decide its value. I know that my life as a teacher will never be quite the same because of it and I intend to do more and more child watching at every chance.

SHAPES, SHAPES AND MORE SHAPES

Debbie Buffington

Sitting on the shelves in my kindergarten classroom were a number of activity kits that I had only briefly glanced at and for the most part ignored. They had been there when I moved into the room so I hadn't paid much attention to them. On occassion my little ones would play with them but not with any particular interest or goal.

A few weeks ago I started examining these activity kits and scolding myself for not taking advantage of them sooner. One of the kits was made up of plastic multi-colored shapes. The shapes were red, blue and yellow and of different thicknesses. Some were small and large circles, small and large squares, and small and large rectangles. The other kit was made up of large flat pieces of cardboard with parts of different shapes on them. Some of the puzzle-like pieces were square and some rectangular (the size of two squares together) and others triangular. Some of the shapes appearing on the pieces were circles, squares, arrows, rectangles and x's. The final kit was made up of strings and circular and square beads. The wooden beads were different sizes and colors. Patterns were available for different arrangements of the beads.

I divided the class into three groups. Each group had a different activity kit to work with. We kept rotating kits over a period of several days so that everyone had an opportunity to work with each different kit. I kept walking around the room observing the children working/playing and occasionally making comments.

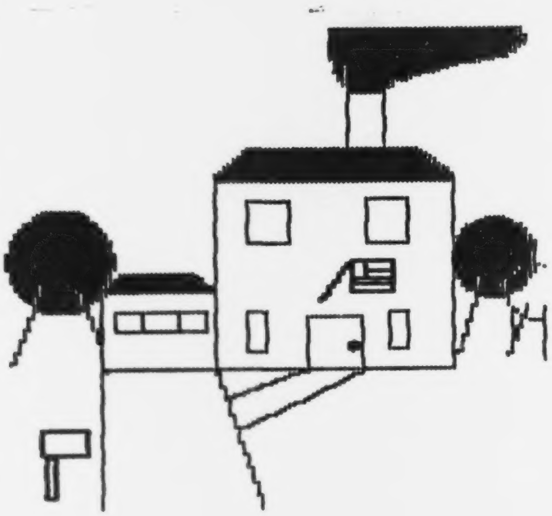
The children who worked with the plastic shapes made some incredible structures. Some of the children made elaborate houses several inches high. One little boy named Greg made a stand up house with a swinging front door. Justin also made a house surrounded by a fence. The fence was made up of small rectangles balanced on the long edges. Daron, who has a hard time sitting still, made a large arrow consisting of several shapes fitted together. Katie made a robot. Several of the kids would stack the shapes on top of each other and pretend they had made sandwiches. The yellow shapes represented the cheese.

Those who worked with the flat puzzle-like pieces also came up with some elaborate creations. Shawn made all sorts of water animals. Mike made a house using four squares and a triangle on top. Cory informed me that his creation was a candy store and not a house. Todd put the puzzle pieces together and made a circle. He seemed content with his creation and reluctant to go on, but eventually he did. Tina stayed with the triangular shapes and made all sorts of creations. Gregg, who is very much into Star Wars, made all sorts of space ships and rockets. Some of his creations involved cards balanced on their edges. At times the kids would argue about sharing certain cards, but the problems always seemed to resolve themselves.

Those who worked with the beads were allowed to chose whichever pattern they wanted to create. After they had accomplished a certain pattern they would ask me to check it. One thing that really interested me were their substitutions. Often they would have to substitute a certain color or size bead because the one they needed was already in use. They always made it a point to inform me of why they substituted different beads. I thought this was an interesting twist. One little girl, Staci, kept having trouble with a certain pattern, but she never gave up. She beaded the string several times before she eventually accomplished her task. Katie didn't want to follow a pattern. She wanted to make her own design. Several of the children would pretend that they had made necklaces.

We worked for approximately thirty minutes each day, and the time flew by. The children were very absorbed in what they were doing. On occasion one or two of them would drift away from their table to see what the other kids were doing, or they would express a wish to work on a different activity kit.

Usually when I ask the kids to get their math workbooks I get a lot of moans and groans, but when we were working with the different shaped material the kids kept asking me how much longer they had to wait for math. Their enthusiasm was contagious. Wouldn't it be great if I could have this kind of enthusiasm every day for every subject!!



Betsey Tucker, Age 11

1880

"I'M GLAD I DIDN'T HAVE TO PAY FOR ALL OF THIS"

Margaret Gilligan

It was the Tuesday before Thanksgiving. My sixth-grade class had just finished correcting a page of math problems from their textbook dealing with pirates and doubloons and walking the plank --word problems requiring some multiplication, some division, and coping with remainders.

"I hate these problems. They're dumb!" came the mumbling from behind my back, and I couldn't agree more. They had no idea what doubloons were, had never heard of walking the plank, and had no idea what to do about those remainders anyway. But they certainly seemed to need practice.

On impulse, I sent someone to the office to find out how many students were currently in our building, and found out that it was currently 372 students. The children had just had a particularly dreary version of a cafeteria Thanksgiving dinner. We started talking about how they prepared the meals in the school kitchen. I briefly explained how they figured the size of food portions and we began figuring out what it would require to prepare an old-fashioned turkey dinner for all of the students. After working out how many ounces, pounds, and pieces it would require, I told them how the food would be purchased, and we worked out how many pounds of turkey and potatoes to order, how many cans of cranberry sauce and green beans, packages of rolls, cartons of whipped cream, and how many pies to bake.

The next morning I gave them cost figures for all of the items, and they figured out how much the total cost would be, and finally the cost per student. They worked on this steadily, and it took nearly all day before all of the students finally got it all worked out. When to divide and when to multiply gave the greatest problem, and of course what to do about those remainders. But when not coping properly with a remainder meant seven students would not get a complete dinner, it was somehow easier to visualize, and they enjoyed the whole project, although as we lined up that afternoon to leave for the holiday, several students vowed that they would not eat green beans for Thanksgiving dinner.

Monday morning, some of them were still laughing as we compared notes on our holidays and particularly on what we had for dinner. A few even admitted to having had green beans. And one of the students spoke for several when she said that as she was eating her Thanksgiving dinner, she suddenly thought, "I'm sure glad I don't have to pay for all of this."

CONTRARY TO POPULAR BELIEF, CHILDREN CAN THINK

Cindy Fox

Why don't we listen to children? Is it because we think "Children should be seen and not heard?" Is it because we think they're too young to have anything worthwhile to say? Children have brains, why don't we let them use them instead of making them go through mechanical motions. Too often we judge that children have no ability for logically thinking things through. We don't listen to what they have to say but we certainly expect them to listen to us. If we expect children to respect our thoughts we should respect theirs. Children sometimes see things from a perspective which we can not see.

Young children do not think in the same way as adults; they think in their own particular way and they don't understand why we can not see things their way. Piaget called this egocentric thought and described it as typical of the concrete operational stage of thinking. (Sometimes I wonder if many adults have ever moved out of this stage.) Some teachers do not watch children think or seem to care how they think. They seem to view school as an assembly line that children must go through like they were assembling a car or something giving no thought to a child's individuality. Different children think differently and we must find out which way they learn best in order to teach them. The only way to know how a child learns is to watch how (s)he thinks and listen to what (s)he has to say. One never knows, one might learn from the children.

I have learned more this quarter by observing the children's thinking than I could ever learn from any textbook or college course. Why teachers think that all children learn alike is amazing to me.

Not all adults think alike and in the same way so why do we expect children to?

If children think, why don't we give them something stimulating to think about? Too often we give them worthless things to do and that is boring. If children see learning as boring and worthless then nine times out of ten it is the teacher's fault for not motivating and stimulating his/her pupils. Let's give children an opportunity to develop their thinking and something to think about and watch what happens!

Ricky Olegschlaeger, Age 11

BUILDING RELATIONSHIPS WITH CHILDREN

Margaret Moffatt

It has been a belief of mine that in order to work effectively with children, one must first establish a relationship with them. This belief has been reinforced by some recent reading I have done. (See Lives of Children by George Dennison, One Child by Tobey Hayden, Someone Else's Kids by Tobey Hayden)

I work with autistic, emotionally disturbed, language impaired, and behavior disordered children. They are kids who cannot function in a regular classroom. One of the children, Nate, is an extremely aggressive child. When he gets frustrated with school work (or other children or teachers) he deals with the situation by becoming aggressive. Last year, a typical day for Nate might include anywhere from 25 to 100 aggressive incidents. Nate has poor language skills, so he cannot ask another child to move out of his way, so he hits or pushes the other child.

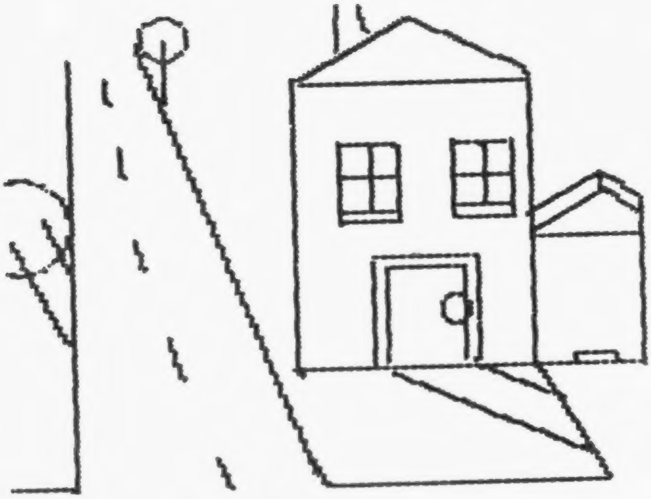
Nate's previous teachers have traditionally been afraid of him; probably no teacher has ever liked Nate.

This year, Nate is in a room with a small pupil-teacher ratio. He gets much more individual attention from teachers who genuinely like and enjoy him.

Our first goal was to build relationships with the children. Much time was spent talking to the kids about themselves, their families, what they like or do not like. There is also a lot of touching and hugging in our room. We state things positively whenever possible.

The children in our room have responded beautifully to this atmosphere, especially Nate. His incidents of aggression have been dramatically reduced -- an average of one per week! He is responding to verbal direction without becoming aggressive. He loves school and gets very upset if he has to miss.

The change in Nate is evidence of what can happen for a child when teachers take the time to build relationships with their students. In essence, it can be stated very simply: The student is more important than the program.



Chris Edwards and Betsey Tucker
Ages, 11

INTERVIEWS

Dorothy Simpson

I interviewed eight beginning second-grade students. Each student was given three tasks. Descriptions of the tasks and the students' responses are as follows.

Task 1

There were 9 cubes on the table. The students were asked to count them. I then covered 5 of them. Four cubes were left showing. The students were asked to tell how many cubes were under the cover.

Responses:

Melanie counted the 9 cubes by touching each one. She used her fingers to count from 4 up to 9 to find out how many cubes were hidden. Her final answer was 5 cubes covered.

Brad touched each cube as he counted it. He said 5 cubes were covered because 4 + 5 = 9 and 4 were uncovered so 5 were under the cover.

Brandon did not touch the cubes to count them. He calculated that 5 cubes were under the cover. When asked how he figured it out, he responded by saying "I counted in my mind."

Jill did not touch the cubes. She said 5 cubes were hidden because 4 + 5 = 9.

Angie touched each cube as she counted. She seemed to forget the original number of cubes when I covered 5 of them. She said there were 7 under the cover but could not explain how she arrived at that number. We tried the task again. The second time Angie said there were 6 cubes hidden and again could not explain her method of calculation.

Ben also touched each cube as he counted. He was able to tell me that 5 cubes were hidden. He said, "There are 4 here so you have 5 covered." When asked to explain how he arrived at 5 he said, "I just guessed."

Carrie touched each cube as she counted. She was able to calculate that there were 5 cubes hidden. Her explanation was that 4 plus 5 equal 9.

Trevon counted the original 9 cubes by twos. He said there were 5 cubes hidden because 9 minus 4 was 5.

In summary, five children explained this task as a missing addend problem (4 + ? = 9). They did not subtract 4 from 9, however. They counted from 4 up to 9. Only one of the five students used her fingers to find the solution.

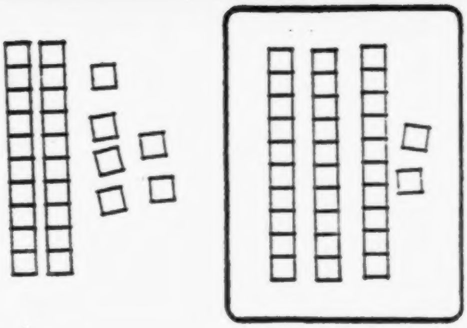
One student approached this task as a subtraction problem (9 - 4 = 5). He was the only student to count the 9 cubes by twos.

The other two students were unable to explain their method of calculation.

I feel that these students had memorized the addition facts and were merely repeating them back to me to explain their answers. More interviewing would be needed to establish the true foundation of their number knowledge.

Task 2

Count the number of cubes showing. When the covered cubes are revealed, count the total number of cubes.



Responses:

Melanie counted the uncovered cubes by ones. When the rest of the cubes were shown, she started at 26 and counted them by ones.

Brad counted one 10 by ones then said there were 10 in each stick and there were 6 small boxes. That equals 26. When the total number of cubes was revealed, he said, "5 bars of 10 equal 50 and 6 singles plus 2 singles equal 8 so the total is 58."

Brandon used the same strategy as Melanie. He counted the uncovered cubes by ones then started at 26 and counted the rest of the cubes by ones also.

Jill counted the uncovered cubes by ones then realized that each stick was 10. When the rest of the cubes were revealed, she put all the 10's together and all the ones together. To find the total, Jill counted the sticks by tens and the singles by ones and arrived at the answer of 58.

Angie counted the uncovered cubes by ones. When the other cubes were revealed, she started over and counted the entire group by ones and arrived at the answer of 60.

Ben counted using the same method as Angie. He also made a clerical mistake and came up with a total of 57 cubes.

Carrie counted the first addend by ones. When she was given the second addend and asked to find the total number of cubes, she began counting the second by ones starting at 26. She arrived at the correct answer.

Trevon counted one stick by ones. He then said, "10 plus 10 is 20. 20 plus 6 is 26." When the entire group of cubes was shown, he put all of the tens together and said they equaled 50. The ones equal 8. His final solution was 58.

In summary, 5 of the children saw both addends as a combination of single units so they counted them by ones.

The other 3 students were able to utilize the grouping of 10 single units into one unit. They counted the first addend by 10's and ones. When shown the second addend, they moved all of the tens together and counted them by 10's then added 8 ones to arrive at a total of 58 cubes.

Task 3

"Why do we study math?"

Responses:

Melanie: "We need math for school."

Brad: "We study math to learn the answers. You use it when you get a job."

Brandon: "We study math so we can learn."

Jill: "Math helps you add and subtract."

Angie: "We study math to learn plusses and stuff like that."

Ben: "Math helps you count and helps you get smart."

Carrie: "We study math to learn plus and equals. It helps you when you go the grocery store and have to pay for things."

Trevon: "We study math to learn and take tests. You have to know it to make sure you don't get cheated when you get change back from the store."

All of the students interviewed stated that math was something a person needed for school. Five of them did not view math as having any application to real life situations. Three others noted that math was helpful when going to the grocery store to insure that one received the correct change. Also, math would help one in his occupation.

The underlying idea in all of the responses dealt with being able to give the correct answer to math problems -- not the understanding or application of mathematical concepts.

Julie Fisch, Age 10

cuttings

Teachers' Center Participants are asked to keep diaries of their observations of children's thinking, notes on good things they've read and ideas they don't want to lose.

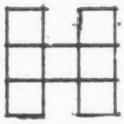
Cuttings are excerpts from these diaries. We've simply lifted a paragraph here, two paragraphs there and a whole page from yet another place. They haven't been edited. They are just unpolished ideas that are too good to remain between the covers of someone's notebook.

We print them here because one major rule in the Teachers' Center Project is "If you come across something good, you're not allowed to keep it to yourself!"

CUTTINGS

Judy Barnett

This game was done with volunteers in an eighth grade study hall.



Place the numbers 1-7 in the squares so that the sum of every horizontal and vertical line is the same. Can it be done so that horizontal, vertical and diagonal lines have the same sums?

I put the problem on the board for anyone who wanted to try to solve it. After the few simple instructions several students started to work enthusiastically on this problem.

Jeff, 13 years old, said he just counted in his head and found the sum of 12 worked. He did this very quickly and then looked at it and was delighted when he realized it added up diagonally, too. Then he continued to look for other sums. After some attempts at other sums and finding a solution with 11, Jeff stated that you can't get a sum lower than 10 because of the way the highest and lowest (7 and 1) add together.

Kennet, a 14 year old boy who is usually not interested in anything, discovered one number combination that added up to 12 and it took him quite a while to get it but found a second sum answer of 11 easily. After a great deal of study he said that 13 is the highest you can go to because the numbers aren't big enough. If you had a bigger number then you could. He discovered that 12 could or could not be added diagonally depending on how you lined them up.

John, a 13 year old, eventually found a solution for the sums of 11 and 12 and decided that you couldn't find a way to add the 11 problem to add diagonally and nobody disagreed with him.

Three girls worked together in a corner of the room and I didn't realize they were working on this project. They found sums of 11 and 12 and one of them found an answer of 13 and quickly proclaimed her success, offering to show it to anyone who wanted to see it. Many refused because they wanted to find it on their own. Jeff piped up saying that he bet it wouldn't add diagonally because it was an uneven number.

All seemed to rely on counting in their heads, not relying on or using scratch paper. Those working made several conclusions. There is no definite pattern or trick to it. There are many possible patterns for the same sums. The tops and bottoms can be switched without messing up the problem. It's fun finding answers.

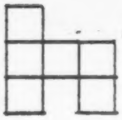
The H problem was presented to a 7th grade study hall for any students interested and who were not doing anything. Jenny discovered that she could get an answer of 12 because she had filled in answers that totaled 10, 12, and 11 in different directions so she switched two numbers and found a solution totaling 11 in all three ways.

Bill, a 14 year old, found an answer of 12 and said he chose 12 (guessed) thinking it would work because it was even.

When I questioned about Jenny's solution of 11 and asked what he thought of that he didn't know. Another girl chipped in that she thought 13 would work but she didn't know why.

Jenny continued to work and found her own answer to 12 different than Bill's. It was important to her to accomplish the task on her own.

Another boy, Mike, 12 years old, came in and tried already knowing that 12 was an answer. He drew his H like this and then continued to try to fill in the numbers.



Then I asked how many different H's could be made adding up to 12 and several started working on that.

Bill decided he wanted to prove Lori's theory of 13 either right or wrong. He went to work. She still didn't have any reasons but was sure 13 would work. Bill proved her right.

I have a continuing reaction from students with whom I have tried my activities. Students meet me in the halls and ask how my projects are going, some take them home to try on others, and there are signs that they are still looking for more solutions and reasons to the H problem and the strategies of Tic-Tac-Toe (a continued thinking process and I love it.)

There is a reaction that I have not mentioned before and that involves the change in attitude and atmosphere with these students. It is now more relaxed, friendlier, warmer and just more pleasant.

As I go in and out of a small grade school about once a week to try my problems on younger students, I see a special welcome with the students I have worked with. Especially with one boy, a fourth grader who refused to do his work. He was standing in the hall when I got permission to work with him and this child seems to have serious emotional problems. When I played Tic-Tac-Toe with him one of his concerns was that he didn't want to beat me too often and it was important that I win occasionally. I guess what I'm trying to say, there is more than math and thinking process that are available to be observed as you work with these students and they can be rewarding.

When I returned the following week to this school, this boy's face lit up when I walked in. (It was not me, it was just that I had had a chance to relate in a different manner) and he reacted positively.

Next question -- what other numbers will work -- 10? Some say yes, some say no. Bill says no, it's just too low. You can't add 7 to the other numbers.

I took pieces of construction paper and cut them into squares. There were five colors and with the help of other students we labeled each color a number -- 1 = white, 2 = pink, 3 = lime, 4 = green, and 5 = orange. Then I asked how many ways could they make 5. There were about 5 eighth grade students involved and each had a stack of colored squares on their desks. They started arranging piles that added up to 5 in neat rows. Jeff announced that he had 7 ways to make 5. Dale agreed and they started comparing their piles when I asked if they were sure they had the same combinations. All working agreed that there were only 7 ways.

Next I asked how many ways they could make 6. The system used was the same as before, using neat piles in rows on their desk. They all seemed to view 6 as an easy task. John found 7 ways to make 6 quickly and Dale said he found 7. Jeff said he found 7 ways so then they started comparing each others' ways. They were amazed to see that they weren't completely the same. The two who found 7 ways didn't have exactly the same 7 ways. Together they found 10 ways. They now were working together and one boy became the unnamed leader. Then they separated and worked separately again but continued to rely on Jeff, the leader, as the authority. I said I thought there were more ways than 10 and so they continued until they found an 11th and then 12th way. At this point one boy stated that he bet there might be as many as 20 ways or even more. They continued and got up to 14, but couldn't find any more and didn't know why. They didn't check for doubles and their system was not efficient. They were more interested in finding a high number. I was surprised that no one got out paper and pencil to make notes. They seemed content to work with the piles on their desks even though it was confusing and difficult to compare because no two did it exactly the same. The confusion didn't seem to bother them. At this point I wrote on the blackboard: 5, found 7 ways; 6, found 14 ways. Then I asked what that meant to them. Their answers were: Six was harder than 5, and seven would be harder yet and have a lot more ways.

I'm sorry we ran out of time because my next suggestion would have been to record their findings but I was hoping they would discover that on their own.

Seventh Graders -- using the 5 colored pieces of paper task -- How many ways can you make 5? Bill quickly lined up seven piles in seven different ways and Wes agreed with him. They thought it was unimportant to compare piles because they viewed the task as an easy one.

Next they tackled the total 6, finding this more difficult. Mike found 10 ways, Wes 10 ways, and Bill found 11. Next they systematically compared, finding a double. I told them the 8th graders had found more ways and said that they were probably wrong and hadn't checked very carefully. The system Bill used for checking was placing all his piles on the top of his desk and having Wes call out his groups. As they were called out Bill moved his like piles to the lower portion of his desk.

Next was 7. They worked independently first. Mike found 13 ways, Wes had 14 ways, and Bill had 13. They were then ready to test. Using the same system with Wes calling out, they found Wes had a double and they all concluded 13 was correct. They were pleased with their system and confused as to why I would ask are you sure that that's all the ways. I placed the 5 = 7 ways, 6 = 10 ways, and 7 = ? Wes had guessed 13, Mike guessed 14, Bill had no guess and I guessed 16.

Eight was the next challenge. They all seemed to think that there would be 16 ways, a progresison of 3 and set out to prove it.

Mike found 14 ways and then 15 and continued to look. Bill hit 14 and stated he only had to look for 2 more. Once they hit 16 they were all ready to check. But while waiting for one to get to 16 Bill found 2 more ways and Mike found 1. The theory was challenged -- need to check. Upon checking they had 19 and found a duplicate so we came down to 18. After checking and rechecking they agreed on 18. Now our numbers looked like this: 5 = 7, 6 = 10, 7 = 13, 8 = 18. The progresison of 3 was broken. When asked what this meant, here are some of the comments: "an odd number gets an odd answer," "an even number gets an even answer," "it gets harder as you get more -- especially in missing duplicates you aren't quite as sure with 8 that you have all the combinations as you are with 5."

I observed a 2.6 year old child with a problem and her solution was fascinating. This child found a softball (which was really soft) and I decided rather than verbally instructing her not to throw the ball in the house, I would roll the ball to her. We sat on the floor and rolled the ball back and forth. Next I put some sideways spin on the ball still keeping it on the floor. After several tries, she managed to do the same. Next I would throw the ball up to myself and catch it after I received it from the roll. She tried the same. She was able to catch it occasionally but her throw was gentle and similar to the way I was doing it. She was not upset when she didn't catch it. Knowing she couldn't handle the next skill, but curious, I would receive the roll, throw the ball up to myself, and clap once before catching it then roll it to her. She tried this and couldn't manage it at all. After she had tried several times she finally placed the ball on the floor in front of her, clapped once, then threw the ball up to catch it, and then rolled it back to me. She was completely satisfied with herself and I was amazed at how she had reacted to this interaction where there were no verbal instructions given.

Guess Who or What? -- Eighth Graders 13 and 14 years old.

The students really enjoyed this activity and many who had not been involved in previous "math" activities joined in this time. At first we started with people in the room but that was much too easy and with good questions could be zeroed in quickly. When I said good questions I mean the students became irritated with a boy who would ask if it was a boy right after the question, "Is it a girl?" They said it was a wasted question and we weren't even counting questions. One boy came up with a person that no one in the group knew and some said we would never guess her but some said we could. They zeroed in on her age, where she went to school, town she lived in, color of hair and then the spelling of her name -- dealing with length, letter of

1st name, vowel, consonant, between A - K, K - Z and finally they discovered her name with the help of one person recording the findings. There was a feeling of satisfation to some in getting this very tough person figured out plus someone felt like he knew her after all those questions. Everyone was interested in getting a turn to be the leader and the group decided you had to guess the right answer to get your turn. They would start a new turn by asking questions, taking turns and moving in a circle. When the group became stumped anyone was allowed to question. They would discuss ways to get it going again. Usually one question from another angle would start the ball rolling. No one stumped the group and many of the people and things were difficult to figure out. Some of the questions were of little value and they usually came from the same people but after a little time, the questioning became quite good.

The students in a group of eight or nine students played the "Guess Who or What?" game. We started timing how long it took the group to guess each time. Five minutes was a good time to stump the group. We always came down to using the alphabet to spell out names and names became fairly quickly solved even when we didn't know the person or if they were totally unfamiliar to anyone in the group. It was discovered that THINGS were more difficult and the group decided that they should be able to get the answer without spelling it out. We also decided that nothing could stump the group if the questions were good. Then they set out to see if anyone could stump the group. The range of items was from buildings (certain individual buildings), places in the world, food items, parts of the body, jewelry, parts to anything else anyone could think of. Everyone wanted turns at trying to stump the group so it was decided that whoever got the answer to the previous item got to be "it". No one stumped the group and the feeling was relaxed, fun, pleasant. One in which no one realized they were learning and growing.

CUTTINGS

Debbie Buffington

My kindergarten class is working on the concept of classification in their math workbooks. I wanted to make sure that they really understood what we had been talking about so I devised a hands-on exercise in classification. I inherited five large containers full of bottle caps from the previous kindergarten teacher. I dumped approximately one hundred bottle caps on each of the four working tables. Each table has either five or six students seated around it. I asked the children to group the caps according to the labels on top. I realize the children are not reading yet, but the more popular brand names were easily recognized. The children eagerly set about separating the bottle caps. One thing that interested me was that some of the children were working strictly independently. They would have their own little piles of Pepsi caps, Pabst caps, 7 - Up caps, etc.. They didn't want to contribute to the larger growing piles of caps. Color was a big factor in classifying the different caps. Some children were mistakingly grouping the gold Busch caps with the lighter gold Pabst Light caps.

It took us two days to finish grouping our caps. I took plain brown grocery bags and taped a certain bottle cap to each one. This enabled the children to put the right bottle caps into the appropriate bags. The children had great fun doing this task and without their knowing, they were strengthening their knowledge of classifying objects.

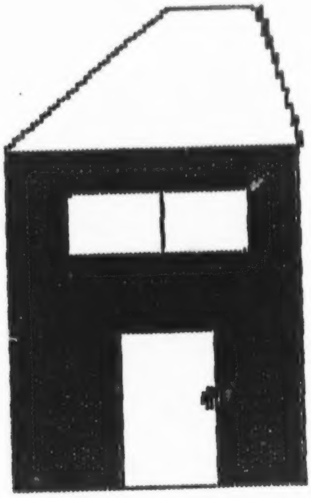
(TOB's comment, "A lovely activity!")

I have been toying with an activity involving addition and subtraction. The idea arose one day when my four year old son, Cory, asked me how old he would be when his older sister reached the ripe old age of eight. Robyn and Cory are two years apart. I turned the question around and asked him how old he thought he would be. (TOB; !) He thought for a while and then gave me the correct answer. (TOB: Learning involves construction and coordination.) I started asking Cory how old he would be when Robyn was 9, 10, 11 and 12, and believe it or not, he answered correctly. I reversed the problem and started asking him how old he was when Robyn was 2, 4 and 6, and once again he answered correctly. When I asked Cory to simply add 2 + 2 or 2 + 4 or 2 + 6 he hesitated and had to mull over the problem for some time, but when the problem was put in terms of his age and Robyn's age, he had no trouble.

This activity worked basically the same way for Robyn. The concept of subtraction is a difficult one for Robyn, but when put in terms of comparing her age to Cory's, she understood a lot better. (TOB: Why is this so? What can you learn from the situation?)

I really don't know what to conclude from this idea, but it seems that if children work with numbers that have a real meaning to them, they can deal with the concept of adding to and subtracting from a lot better. I would like to devise some way to bring this activity into the classroom. My kindergarten class has a long way to go before we tackle the concept of addition and subtraction, but I'm going to keep this activity in mind for when the right time comes along. (TOB: Super!)

While reading SEEDBED 11, I ran across the article by Peggy Read. I was intrigued with her idea of walking through the numbers 1 - 25 so I decided to try it with my own kindergarten class. I made 25 bright orange footprints each numbered 1 - 25. I let each of my 23 children walk through the line while counting. I noticed that over two thirds of them were counting much faster than they were walking. By the time their feet were at the numbers 10 and 11, they were verbally up to 15 or 16. (TOB: Learning involves construction and coordination.) This just proves that even though some children can count without hesitation, they may still lack the basic knowlege of numbers actually representing certain quantities. (TOB: Utterly true! Keep watching.) Also, many of the children were unable to recognize the numbers and if I would tell them to slow down and move back to number 17, they didn't recognize which number was 17. (TOB: !)



Mary Brock, Age 12

CUTTINGS

Fredrica Walker

I just want to comment on instructions and work book pages. I see students given assignments in work books with no verbal instruction from the teacher other than page numbers. This may be appropriate sometimes, but often these second graders can't even read some of the words contained in the instructions. This is what I see: the brighter kids key into the examples given and take off from there; the students that are unable to decode these clues seek help from those they see working; and some kids just do what they think the page calls for. I'm concerned for those that seem confused -- and those whose grades reflect incorrect responses. I feel they may NOT be receiving a fair evaluation...because they don't know what it is that they are asked to do!

CUTTINGS

Margaret Moffatt

Nathan is 10 years old. He is currently working first grade math. He just started a second grade book. He does fairly well with a lot of teacher-assistance.

I asked Nathan, "What is 1 more than ?" Below are the numbers I gave and then his replies:

My #	Nathan's #
6	7
15	16
23	24
36	37
98	99
100	11
121	122
239	240

I'm not sure what threw him about the number 100.

I asked him to count by 10's. He did that from 10 to 100 with no mistakes.

When I asked him to count by 10's starting at 12 he counted from 1 - 12. He didn't appear confused but he didn't understand at all what I wanted him to do.

Jon is 11. He is currently doing multiplication of 3 digit numbers by single-digit numbers.

"What is 1 more than ?"

My #	Jon's #
6	5
12	13
28	29
56	57
100	200
115	16
132	36
212	13

Jon couldn't handle the 100 part of the numbers.

"Count by 10's." All correct.

"Count by 10's starting at 5." "5, 10, 15, 20, 25, etc. to 100."

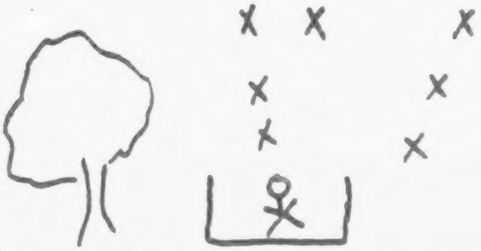
"Count by 10's starting at 12." "10, 12, 14 -- How do you do that?"

I repeated the question. "10, 20"

Debbie Hagemeister

I first asked several students of different grade levels how to play soccer. Their replies are following:

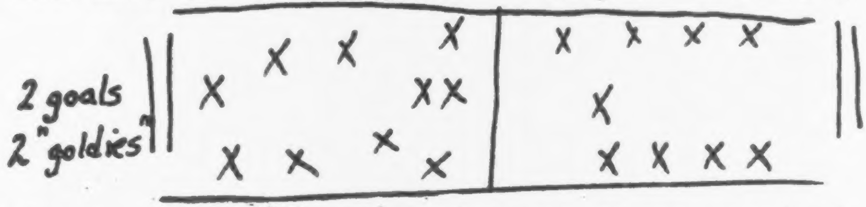
1st grade girl -- she had played on a league -- "The coach is there. He tells you to run to the tree. We all run. Then we kick the ball. It goes into the net." "Where is the net?" I asked. She drew a picture.



"How many people?" "Whole lot. Green team -- I have #7." "How long is the game?" "10 minutes or so." "If coach says "out", you're on the bench. If coach says "in", you're kicking. Oh, we bring oranges for break!"

2nd Grade girl -- "You kick it." "What?" "The soccer ball." "How many people?" "Don't know." "I like it but don't know about it." "Where do you play?" "In gym (PE)."

3rd Grade girl -- "Have to kick the ball." "Have to run -- anywhere." "You can cross the mid-line." "You play on concrete or grass." "You have to hit the goal." "People -- 10 on a 'thing'".



"How long do you play?" "Til you get 10 on a game." "When not off field -- then out -- put another person in."

1st grade boy -- who played on a league -- "You use head, feet, legs, arms and body -- ball bounce off your body -- no hands." "If the guys kick the ball into their goal, other teams get a goal. When the coach blows the whistle, you should stop. When the coach puts his foot on the ball, you should not kick it." "Are there teams?" "Yes. Reds (I am) and Whites (wait -- got too much guys) the Blues. Try not to kick the ball out of bounds -- except the coach says -- you try to kick the ball and score goals -- the other guys try to take the ball away." (TOB: Marvelous!)

Observations:

I observed the younger or less experienced girls did not know why the game was played -- only that you kicked the ball. Color or uniform was noted on 1st grade girl and boy as they had played. They have no concept of how long game lasted. The third grade girl called "goldies" for goalies. She had concept of a field but not of position to stay in. Most know to score a goal was of some importance but not to necessarily win the game.

CUTTINGS

Sally Bolen

Last week I showed the book Look at Annette to my son, 17 month old Kirk. I had predicted that he would only be interested in the mirror. To a degree that was correct but I was surprised in several things.

Kirk did not grab the mirror immediately as I expected him to do. He looked at the picture in the mirror and then took the mirror to try to make a picture himself. He put the mirror on the page at an angle that did not make a picture so he looked at the mirror as if to figure out what was wrong. It then became a toy by itself and not connected to the book. I plan to use the book again before the next class meeting when I have more time to talk with Kirk about it. (TOB: What does he make of the book?)

Much of what children do at this time is mimicing and it has always been difficult for me to determine where mimic ends and true understanding begins. (TOB: What about ? can you find out if he just looks at the pictures?) (TOB: Good ??. Watch language copying and the dawning of his inventing. Watch the change in you .) One indication of Kirk's understanding of body parts came when he discovered that I have a nose. He has been able to name head, eyes, belly and feet for several weeks, perhaps 2 or 3 months. (I had not even thought to have him point them out before until a friend's child, younger than Kirk, could tell where some of his body parts were. Maternal jealousy arose and we took a crash course in anatomy.) While changing a diaper I pointed out Kirk's nose for perhaps the 10 or 15 time. Suddenly he pointed to his nose and said, "Doe." I praised him, said yes, it's your nose, good job and so on. He said, "Doe, doe, doe" and I carried on as before. Then I pointed to my nose and said, "Mommy's nose." He looked at me very strangely and grabbed my nose and said, "Doe?" "Yes, mommy's nose. Here's Kirk's nose and here's Mommy's nose." (TOB: The beginnings of elaboration of doe. How about a dog's doe?) I said and pointed out each nose at the proper time. He grabbed my nose again and said, "Doe." Soon after that he discovered that we shared many of the same body parts, toes, feet, belly, eyes and head to name a few. Occasionally he will approach me and grab my nose or put his finger as close to or into my eye if possible and say the appropriate part. I now feel he understands exactly what those body parts are. (TOB: Note spontaneous rehearsal, perservation, then ??.)

There was an interesting incident with Kirk that has piqued my curiosity. He was playing with two balls, one a plastic orange ball and one a yellow tennis ball. The orange ball was slightly larger than the tennis ball and had a smoother surface than the tennis ball. His game was to put the balls into his clothes hamper then demand that I take them out. On the first round of this game, he put the balls into the hamper and when he couldn't reach them, he pulled the clothing around inside in an attempt to get to them. He was frustrated in his attempt, however, and only succeeded in covering up his tennis ball. When I went to retrieve his toys I took out the orange ball only since I could not see the other one. He remained at the hamper, pointing and indicating that I wasn't finished getting the toys. (TOB: !) When I understood what he wanted, I pulled out some clothes and found the toy. I became interested in knowing how he developed the concept of more than one and how accurate his concept is. We repeated the activity with the two balls and he knew that one remained in the hamper. I was just about to attempt the same activity with three balls when my husband came to take us to St. Louis. (TOB: Bah. Good inquiry.) Kirk is in Indiana this week and I can't do the activity until he gets home.

Last week Kirk and I looked at the book, Look at Annette again. He was more interested in the pictures this time than the last. We looked at the "baby" (Annette) but his interest was more for the bears and balls, both favorite toys of his. We looked through the book with the mirror, Kirk content to turn the pages and let me use the mirror. At the end he asked, "bear" to see the bears again and we went back through the book looking at some of the objects individually. (TOB: How does he identify them? Is he consistent? What about the pictures ???? part of something is shown? You talked about imitations. How about delayed imitation?)

Upon reading about imitation at stage 6 infancy I recall an incident about a month ago. Kirk had been in Sunday School in the morning. While we watched T.V. and played with him, Darryl or I made a sound similar to but not exactly the sh-h-h sound. Kirk stopped what he was doing, lifted his eyes to look into space, lifted his finger to his lips and said "sh-h-h-h." He repeated it several times in the afternoon. On a later date I asked his Sunday School teacher if that was what she said while she quieted the children and she confirmed that she probably had done that.

The mention of the varying sizes of toys made me want to see if son kirk (17 months) knew the meaning of large and small. I placed a large bunny and small bunny on the couch and asked him to get the small bunny, which he did. Then I placed a large tractor and small tractor on the sofa and asked him to select the large tractor. He picked up the small tractor. Later I offered him large and small pieces of cheese and asked him at various times to select the larger or smaller piece. He always chose the smaller piece or occasionally, both pieces. I could conclude only that he does not know the meaning of quantity terms.

One of his toys is a plastic tray with shapes of four fruits that fit into certain spaces on the tray. Kirk had played with it before so it was not new to him. We started with each fruit in its own space. Kirk went first to one fruit at a time, taking it out of the tray, I said the name and he repeated it, then tried to put it back into the place where it belonged. He came pretty close to it and I would help push it into place. He went to each fruit by turn the first time, first the banana then the orange, then the pear then the apple. Then for several minutes he would select a fruit at random, I said the name, he repeated it and returned it to the tray. At one point he misplaced the apple part, tried the other three fruit but returned them to their own space. Finally he found the apple. I asked him where a piece of fruit was by name and he found it. I asked him where the apple was and he picked up a piece of real fruit he had been eating -- an apple. (TOB: Nice.)

Facial expressions

I thought I might be able to see if Kirk could recognize emotions by facial expressions or if he could at least mimic those expressions. I started with happy. I smiled big and asked him to smile too. He looked at me in an interested manner but I cannot say that he smiled. I asked him again to smile and he said "mile" questioningly and continued to look interested. Several more times he repeated "mile" when I told him I was happy and could he smile too. After a while I decided maybe he was acting as happy as he could and decided to change expressions. I frowned and said I was sad. I made sniffing sounds and boo hooed a litle. Kirk thought that was very funny and began to grin and mimic my boo hoo sounds. I decided he must be too young for emotional mimicry. (TOB: What other observations of incongruity?)

On the "nose" business -- he can tell where his nose is or where is someone else's nose but can he tell where is his toy's nose? We talked about several toys and the list goes something like this:

Rocking horse -- nose -- no
eyes -- yes
ears -- confusion (ears are replaced by handgrips)
Stuffed dog -- nose -- yes, after thought
eyes -- yes
ears -- no (they are long and floppy)

Kirk picked up a left over Halloween mask. Grabbing the hump in the middle he said, "nose." He could also find the "eyes" when I asked him to. He had seen us wear it so I presume he had observed where those parts were when the mask was worn.

No wonder children's thinking is different than that of adults. I told Kirk to "sit DOWN to eat you cracker" and indicated a chair into which he must climb UP to sit. He knew what I wanted anyway. How confusing small children must find things when they are referred to from the adult standpoint.

Piaget described imitation in stage 6 of Infancy as having two levels or areas. The first level is representation, when the child is able to imitate immediately without having to try out each step of the action. The other is deferred imitation where the model for the imitated is not present any longer. (Ginsburg and Opper, p. 62 - 63)

Kirk is 17 months and has displayed both types of imitation for quite some time -- a month to six weeks probably. He imitates people, things and sometimes himself.

Some friends were playing with Kirk and a balloon. One of the people rubbed the balloon on her head in an attempt to create static electricity and make it stick to the wall. The balloon fell to the floor since we have a humidifier. Kirk picked it up immediately and rubbed it on his own head and put it on the wall. He laughed aloud because to him the game was imitating our friend. That is an example of the representative imitation.

Several weeks ago we came home from church and had lunch then relaxed in the living room. In an attempt to quiet him to get ready for a nap I told him to sit down and be quiet. He looked at me intently for a few seconds and did what he was asked. Several minutes later he put his finger (index) to his lips and said "sh-h-h." His Sunday School teachers had probably told him to be quiet in that manner several hours earlier. This seems to be an example of deferred imitation. Another example of this occurred when Kirk and I went to the church to do some work in a room just off of the fellowship hall. In that hall was a ladies exercise group. Rather than play with his toys, Kirk watched the women exercising. My husband took Kirk home and I came home later after Kirk was in bed. Darryl wanted to know if I had taught Kirk to touch his toes because when he got home, he sat on the floor with his legs apart, touching his toes.

He has had a virus of some kind recently so when I see him start to vomit or look like he is going to vomit I grab him and head for the bathroom and the commode. After he had vomited several times he felt fine but we were still in the general area of the bathroom. I told him that if he felt like throwing up again to go right to the commode. He grinned at me and went to the commode, stuck out his tongue and made coughing noises. I hurried over and he looked at me, again grinning, to repeat his performance. He imitated himself in an example of deferred imitation, I suppose.

How many balls?

I had made reference to Kirk knowing that he did not have all of the balls out of a clothes hamper even though he could not see them. He had two in his hands and wanted the third ball. I tried the same thing with three balls again and he seemed interested in only two of them. I thought perhaps he needed time to get acquainted with the number of balls so I let him play with them awhile and he still was concerned with only two balls. At a later time he got two balls out of the hamper and looked for the third but when he didn't find it he closed the lid without searching. Ginsburg says that children as young as 9 months know instantly when a given number of things has been disturbed. I've seen examples of that in Kirk but he was not interested in helping me prove it today.

Based on Piaget's experiment with Lucianne, I constructed a slide-out box (match box) from an empty check box. Inside I placed some Cheerios. I did not think Kirk was very aware of boxes like this because it had been in his toybox for some time. When I asked him if he wanted some Cheerios he came to get them. I handed him the box and he looked at me very curiously. I had never given him any Cheerios in a box before and he did not know how to act. He first tried to open the box in the manner to which he was accustomed. When that didn't work, he turned the box over and over trying to find an opening. The turning caused the Cheerios to rattle so he began to shake the box, saying, "Cheerios" repeatedly. Soon the shaking caused one Cherrio to fall out. He did not notice immediately but continued to shake the box. Another Cherrio was about to fall out when he noticed the one on the floor and stopped shaking the box. He ate the one from the floor while looking at the box. When he saw the one about to fall out he picked it up, ate it and pried his fingers into the box. The drawer would not slide out but he did make the opening big enough to shake the rest of them out.

The next experiment was object permanence with three screens and a pencil. I repeated the experiment just as Piaget described his own with Jacqueline. When I asked where the pencil was he sat back in his chair and looked at me for a long time. Thinking perhaps the screens were out of his reach I pushed them all forward at once, taking care to show no partiality to one or the other screen. He sat up in his chair and correctly lifted the third screen to discover the pencil.

I seemed to remember somewhere Piaget or someone else perhaps doing work with partially hidden objects. Piaget working with younger children I suppose now. I selected some toys with which he was familiar to see if Kirk could correctly identify an object by looking at only part of it. I put several toys in the clothes hamper and used the lid as a screen behind which to hide the largest part of the toy. Following are the results.

TOY	PART SHOWN	CORRECTLY IDENTIFIED
doll	hand & fingers	Y
bear	nose	Y
hat	edge	Y

ball	edge	Y
puzzle	edge	N
puzzle	edge	N
block	corner	N
book	bound end	Y

He did fine on the first few but the orange puzzle part confused him. He called it a ball and when I said no, he re-identified the book with which he was playing. Each time he incorrectly identified the object, he reidentified some other object of which he was sure. (TOB: NICE!!)

The reading in Piaget's Theory of Intellectual Development pp 80 - 81 discusses transductive reasoning, seeing a relationship between two or more concrete objects where there is none. Although it is identified as a characteristic of children between ages 2 and 4, I have seen it in my 18 month old son, Kirk. He likes to watch "Sesame Street" on television. One afternoon he looked at the blank television and began dancing up and down, pointing at the set and saying, "Ernie, Ernie." He had reasoned that when the television is turned on, he watches "Sesame Street"; therefore, if I would turn on the television, "Sesame Street" would be on. He is not acquainted with program scheduling. (TOB: !)

When we call his grandparents we usually let Kirk "talk" to them on the telephone. One evening they called us and Kirk would not talk on the phone, only listen. Late in the night the phone rang. Kirk thought he could talk to them again so he began to repeat, "Memaw, memaw." When the grandparents call the phone rings; therefore when the phone rings it is "Memaw." (TOB: Lovely!)

CUTTINGS

Maggie Burhite

My five-year-old son, a few days before Christmas, was anxiously awaiting his grandparents' arrival, and for the hundredth time he asked me how many days it would be until his grandparents' would get here. I replied, "three days". He looked quizzical and said, "How many sleeps is that?"

In a science methods course I took at another university, we worked with 5th and 6th graders in science activities. The children had only been exposed to "textbook" science, so we started with individual learning centers. The children loved them, and after a few weeks we moved on to whole class involvement. As a class we worked on circuits, interactions, and classifying activities. It was a tremendous success. The kids didn't want to stop the activities when the time was up. The most curious reaction was from the 5th and 6th grade teachers. Three out of four were almost negative about the activities. While the children were exclaiming "Look at this!" "Wow," and proudly announcing their discoveries, the teachers sat at their desks grading papers, puttering, and in general trying to look unimpressed. One out of the four teachers wanted copies of our activities, and got involved with the children along with us.

My 5-year-old, Brent, decided he wanted to spend his Christmas money. He had a $2.[illegible] bill, a $1.00 bill, several pennies and a quarter. We went shopping and he purchased some smelling stickers. His one dollar bill and all 15 of his pennies covered the bill.

Although happy with his purchase, he was unhappy that he had spent most of his money. I tried to explain that the $2.00 bill was equal to two $1.00 bills and that all his pennies were not worth as much as the one quarter he had left. He listened and said, "Will you give me 10 pennies if I give you my quarter so I'll be rich again?" I realized, of course, that he wasn't able to understand -- thought of Piaget -- and left the shopping center with one fairly confused child.

I decided to experiment with an open ended question -- "I like stories about ....?" I asked 6 five-year-olds this question and all of them gave me the title of one story i.e. the Three Bears, The Biggest Bear, Rabbit and Skunk are Friends, Jack and the Beanstalk, etc. I asked several third graders the same question and got the following replies, "dinosaurs, sports, horses, pets, dogs and cats." Categorizing and the ability to generalize seems to be hard for the five-year-olds. This might explain why counting is a problem for young children.

The third graders I'm working with were to address an envelope using proper form, punctuation, etc. Getting them to write small enough to get the address and return address on the envelope was a real challenge. Well over half the children were not able to do this on the first try -- they kept erasing and erasing. They had trouble judging what the size of their writing should be in relation to the size of the envelope. I found this interesting.

My five-year-old asked for a "ham and cheese" sandwich without the "ham" for lunch the other day. I thought, "Why couldn't he have just asked for a cheese sandwich." It gave me some insight into his ability to think in a deductive manner.

In general, the experiences I have had this week have reinforced the concept that young children have trouble generalizing. Thinking abstractly is still a problem for them. This would support the reading I did on the trouble children have with counting. Counting by rote up to about 13 is specific -- then abstract thinking has to be used to develop a pattern for further counting.

I think young children have trouble expressing themselves on paper because of the intangibility of their thoughts. I can't think of a better exercise in creative writing than to have the children record their findings. In a science class I was working with, I had the children record their observations after combining baking soda and vinegar. All of the observations in writing were different and very creative. A few I remember were, "like a hissing volcano", "lots and lots of bubbles dancing -- so happy they danced right out of the cup."

My 5-year-old looked very dejected the other day. I asked him what was wrong, and he said, "I'm sad because my head is shaped funny." I asked him what he was talking about, and he said, "Some lady at school said I was a little towhead...is my head shaped like my little toe?" I explained to him that towhead meant having nice blonde hair and he felt better. If he hadn't verbalized this, he might have gotten a complex about the shape of his head.

I played 20 questions with three different age groups.

Ages 5 and 6 -- Would ask questions like "Is it big or little?" I had to remind them several times that the question had to be answered with a yes or a no. About every other question, they would guess a cow, a pig, etc. In general, they had trouble asking questions.

Ages 8 and 9 -- They were fairly good at asking questions that could by answered yes or no, but none of them thought to narrow down the category by asking, "Is it a farm animal, -zoo animal"- etc. They, too, seemed to want to guess a specific animal without waiting for additional information.

Ages 12 and 13 -- They played very well, and narrowed the categories down by asking such questions as "Is the person on TV, Does he live in the U.S., etc.

Along with the observations already mentioned, I was amused by a comment my 5-year-old made this week. He crawled up on my lap and said, "I'm tired, is it my bedtime yet?" I was a little startled and wondered how long he has been staying up later than he wants to without any idea that he could go to bed earlier.

One day while teaching preschool, I overheard our custodian (Mr. Brevik) saying to some children who were in the hall, "You younguns have a good day!" A few seconds later a very unhappy little girl entered the room. She said, "I used to like Mr. Brevik but I don't anymore." When I asked her why, she said, "He called me an onion and I'm not an onion."

Another example of this happened to a friend of mine who was a kindergarten teacher. In frustration one day she muttered to a child that he was being a "disturbing element". She told me that she wasn't really thinking when she said it and just assumed that the child had ignored the remark since she knew he probably hadn't understood what she said. You can imagine her embarrassment when the next day the child's mother asked her if she really had called her son a "dirty elephant."

This week I used tangrams with two different age groups. I just gave the pieces to each age group, but didn't mention that they were to be put together in any certain way.

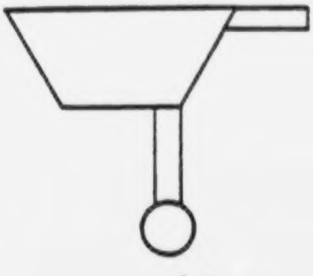
The five-year-olds immediately started making objects out of their shapes i.e. a house, sailboat. Then they went on to discover you could make a big square and a little square out of the shapes. In general they seemed very creative in their approach.

The twelve-year-olds I gave the tangrams to automatically tried to put them together as though the pieces were a puzzle. They seemed to have the need to structure, and find some connection between all of the pieces.

In general, I felt the five-year-olds showed more creativity in working on this activity.

This is not an original idea, but I don't recall its source.

Comment on this wheelbarrow.



The five-year-olds I asked said:

"That could hold a lot of dirt."

"You could tip it and make a slide."

"It would hold a lot of mud."

"Can I color it?"

The twelve-year-olds I asked said:

"The wheel is too small."

"The handle is too short."

"The wheel is not in the right place."

The article mentioned that older children and adults tend to criticize what they see. The directive was to comment on, NOT criticize the wheelbarrow. Younger children tended to be more creative in their comments on the wheelbarrow.

In both the tangram tryout and the wheelbarrow tryout -- the greatest amount of creative thinking came from the 5-year-olds. This makes me wonder, do we stifle creativity as the child progresses through school, or do humans -- as they get older naturally structure and criticize to give order to their thinking and environment?

My 5-year-old came in the house the other day and said, "Do we have any cat food?" I said, "No, because we don't have a cat." He replied, "Well, I've got to find something to feed the cat that's outside." I said, "Brent, I don't want you playing with strange animals." In a very exasperated voice he said, "Mom, it's not a strange animal, it's a cat."

I think that most small children think of the word "strange" as meaning odd, scary, or something never seen before. Therein lies the problem of warning children about strangers. We tend to say, "Don't take candy from strangers," or "Don't get in the car with strangers." I think that in a child's mind he visualizes a stranger as being recognizable by being odd looking or acting. When a "normal" looking person speaks nicely to them, even though the child has not seen them before, this person quite possibly may not be perceived as a stranger.

We move quite often and it has become an accepted way of life for my children. My five-year-old asked me a couple of weeks ago, when we would move again. I told him not for two more years. He said, "How long is that" How do you explain two years? I finally just said, "You are five now and we won't move until you are seven." He seemed satisfied with that answer. A followup of that conversation happened this week. He came home from school and noticed the drapes were down in the family room (I was airing them). He looked horrified and said, "Oh, my gosh, am I seven already?"

This example did not happen this week, but I wanted to relate it as an example of how teachers can unknowingly misrepresent information to children. One of the teachers in the preschool was shook up one day when a mother jokingly told her, "Do you know you have taught my daughter that this is her right hand and this is her wrong hand." In trying to figure out how the child had gotten this interpretation, the teacher found out that the Pledge of Allegiance was the culprit. Everytime the class would say the pledge, this child would put her left hand to her chest -- the teacher would then say "wrong hand". When she switched hands the teacher would say, "that's the right hand", thus this child came away thinking she had a right hand and a wrong hand.

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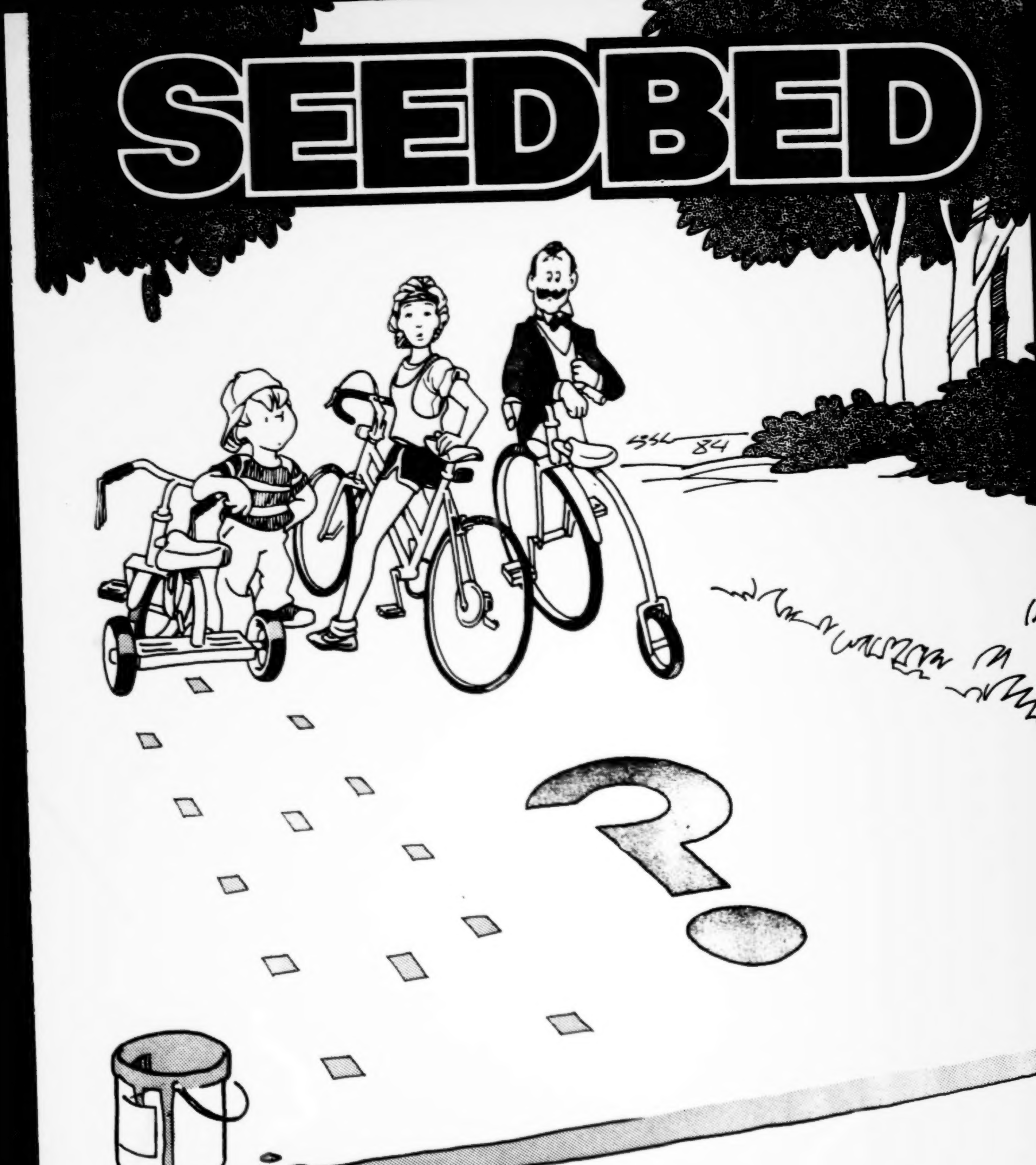
SEEDBED



1927

SEEDBED

NUMBER 19

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Teachers' Center Project

SIUE

Southern Illinois University
at Edwardsville

1928

INTRODUCTION

This is a difficult introduction to write. With SEEDBED 18 and 19 Shirley Casey finishes 9 1/2 years with the Teachers' Center Project. If what follows appears to be tear-stained, you're right.

(Shirley Casey worked at SIUE for 9 1/2 years. Her salary at best was half of that of a first year New York City policeman. She was low person in the academic charts, despite having published and presented more, nationally and locally, than 90% of her SIUE School of Education colleagues. SIUE's recent fiscal crisis made her position shaky at best. September last, it was only within days of school's start that she knew that she had a job for the 1983-84 year. In November, her Bill -- out of work for three years thanks to the local economy -- took a job in Colorado. Shirley stuck around, Bill-less, to fill out commitments at SIUE and leaves now to catch up with her husband and to begin a new life.)

The 19 SEEDBEDs in which Shirley has been engaged as editor, mother-hen, and intellectual gardener have indeed represented a major breakthrough in American education. They have said, loud and wide, that teachers are capable of good and original educational thinking, that a point of view (rather than mere bits and tricks) is essential for teachers and for education in general, and that schools are for kids. Perhaps most important, they have said that knowledge is not a spectator sport.

About SEEDBED 18 and 19: Shirley is responsible for these two SEEDBEDs, but a great deal of credit is due as well to the teacher-authors whose work appears herein, and to Ed and Shirley Labinowicz (CalState/Northridge), many of whose seedlings gave rise to local teachers' research, development, and growth.

I hope that you will take some of these ideas and grow and try an bend them yourselves. As is usual with SEEDBED, what's here is not for passive reading but for action, action on behalf of children and on behalf of excellence in education.

It is commonplace to see a person off with a polite bureaucratic "Good bye and Good Luck. Back to business as usual." But the Shirle Caseys of the world are not commonplace, nor is this Shirley Casey a bureaucrat. Best to say this... Thank you, Shirley, for your untiring efforts on behalf of children and teachers, for your good sense and your good ideas and your willingness to share them, and for your grac and your cheer and your personal sacrifice in the face of incredible local bureaucratic ineptitude. Education is NOT a matter of bureaucracies, as you know; it's concerned with people and ideas and their growth. You have touched thousands of lives of teachers throug your work with the Teachers' Center Project and, through them, many thousands of lives of children.

Some years ago I asked the great George Polya, "What is a teacher?" "A teacher is the midwife in the birth of ideas," he said. "But what a teacher really teaches is himself. Whatever he or she is, the students will be."

Shirley, you are a person of quality; that's what you taught.

Thomas C. O'Brien, Professor
University City, Mo
7 March 84

THE SEEDS

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ABOUT THE COVER

What's all this about bicycles? The SEEDBED cover came from a lovely problem John Mason's recently published book, Thinking Mathematically (Addison Wesley). The problem; You are riding on a straight path which crosses a road at right angles. The road has a freshly painted white stripe down its middle. You cross the line and continue in a straight path. What paint tracks will your bicycle leave?

We chose the art not merely because the problem is a good one, but because the book is one which readers need to know about. The issue is problem solving from a Polya-esque point of view. Rush out and buy a copy, sez I. Better, install Thinking Mathematically as a standard text for kids any grade from 9 through 12.

Thomas C. O'Brien

THE TYPEWRITER KEYBOARD - THE FIRST STEP TO COMPUTER COMPETENCY

Helen L. Miller

As more and more classrooms are being equipped with computers, it is essential that children learn to use the keyboards proficiently. For children, as well as adults, the use of the keyboard is the most confounding aspect of the computer.

Although "hands-on" time using the computer is at a premium in most schools, there are probably some old typewriters available that will serve the same purpose. If children have the opportunity to explore the keyboards, to discover what happens when certain keys are punched, to gradually find what will happen when a particular arrangement of keys is used in sequence, they will be learning the most difficult task required in using the computer -- how to use the keyboard.

The activities which follow can be used with children of all ages. They begin with general exploration of the keyboard and can be expanded in many ways, depending on the interest and the developmental level of the student.

These activities will facilitate understanding of written language for the child who is having difficulty with manual dexterity, also. He or she will be able to express his or her thinking without the encumbrance of having to physically construct the words.

All children have the right to become computer efficient. Typewriters will help narrow the gap between those who have used computers and those who have not.

STEP 1

Let each child have time to explore the keyboard. Time can be allocated during the day by using a kitchen timer.

Decide what amount of time can be given to each child to use the typewriter. This can be decided by the children themselves within limitations of other activities that require quiet concentration. (This is also an interesting way for the children to become aware of how long five, ten, or thirty minutes is. They may be amazed to discover that five minutes waiting time is as long or as short as five minutes typing time, depending on which time is theirs.)

Be sure each child begins his time with a clean sheet of paper. This paper should have his name on it. The first day the paper is to be taken home in order to make parents aware of what the child is working on in the classroom. A short note from the teacher will make the parents realize the purpose of the activity -- to help the child use the computer more efficiently. (Some of the parents may have old typewriters that they would be willing to share with the class.)

Another aspect of using the typewriter in the classroom is that it can be used to motivate the children who have not learned to write their names too well to become more proficient at making their names legible. If a sign-up sheet is made, each child who wishes to have a turn must write his name legibly on the paper. This facilitates reading other children's names too.

The child who has completed his turn must cross his name from the list and get the child whose name is next on the list.

When the children become more adept at using the keyboard, one of the members of the class can type up a list of those who wish a turn using the typewriter.

STEP 2

When all of the children have had the opportunity to freely explore the typewriter keyboard by themselves, ask the following questions:

1. Are there numbers on the keyboard?
2. What are the numbers that you can type?
3. What letters are on the keyboard?
4. Are there any other marks besides numbers and letters on the keyboard?
5. Tell about the other marks on the keys. What do you think those are for?
6. Can you find this mark, "?", in your books? What other marks can you kind in your books that are the same kind as those on the typewriter keys?
7. What happens when you touch the bar on the bottom of the keyboard?

If the children are not sure about the keys mentioned in the questions, let them discover for themselves what the keys and the space bar do the next time they have a turn using the typewriter.

The children will be more prone to remember the particular keys if they have had the chance to find them by themselves.

STEP 3

Now that the children are aware of the various keys on the typewriter keyboard, give them the opportunity to answer these questions as they take their turn.

1. Can you type all the letters of the alphabet starting with A and going to Z in alphabetical order?
2. Can you type all the letters in alphabetical order -- backwards starting with Z and going to A?
3. Can you write the letters of the alphabet starting with A using lower case letters?
4. Can you type all the letters of the alphabet alternating capital and lower case letters? i.e. A b C d E f G etc.
5. Can you make a capital letter and the same letter in lower case?
6. Can you use the letters on the keyboard to make your whole name?

STEP 4

When the children have had sufficient time to do the previous activities, be sure that they are finding the answers to the questions themselves.

If some of the children are having difficulty, it would be advantageous for several children to work together. Those who have had less difficulty relating to the keyboard will be able to reinforce what they have learned by helping those who are having trouble.

Each child should be responsible for typing his name on each of his papers. These papers can be kept in a folder available to the child when he has his typing time.

Some of the children may wish to copy words from their books.

Perhaps, they could be given short notes to copy that relate to some coming event, such as a puppet show or a class project. The typing skills may be rough; the main purpose of using the typewriter is to acquaint children with the keyboard, not to train them to be secretaries or skilled typists.

STEP 5

"What are the numbers on the typewriter?" This may seem to be a very simplistic question, but it is necessary for children to become familiar with the way to make the numbers above nine. This is taken for granted by adults, but may be a problem for children who are just beginning to learn numeric symbols.

1. How many numbers can you make on the typewriter? (Be sure to explain that you are referring to numeric symbols that are different, and not to the number of times the "2" key can be punched.)
2. What number can you type that means the most of something?
3. Can you type the number that means one more than "2"?
4. Can you type the number that means one more than "8"?
5. Can you type the number that means one less than "4"?
6. Can you type the number that tells how many fingers that you have on one hand?

STEP 6

1. Can you type the number that means one more than "9"?

2. What two digits do you need to type in order to type the number that means one more than nine?
3. Type all the ten's numbers that you can. After you type a ten's number use the space bar and then make the next ten's number.
4. Can you make another number that has two digits that is not a ten's number?
5. Can you make a number that has three digits; four digits; five digits? (Be sure that you leave a space after each number i.e. 23 44 37 87 etc.)

(Note: Be sure to differentiate between a number and a digit. The number term refers to the quantity certain numeric symbols represent. A digit is the symbol itself i.e. "28" is a number consisting of the digit "2" and the digit "8".)

TEN

Mary Ann Toenjes

"Ten" is a card game involving computation, logic and strategy. It is played with a regular deck of playing cards in which the Kings, Queens, and Jacks have been removed.

OBJECT:

To make pairs or groups of addends that equal ten. The player who finds the most groups of addends wins the game.

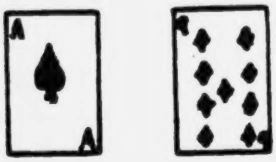
NUMBER OF PLAYERS:

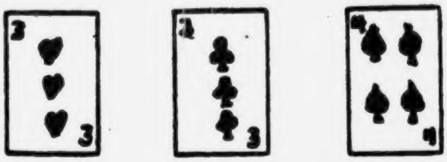
Two or more -- for more than two players, it is necessary to use two decks of cards.

PROCEDURE: (Similiar to Gin Rummy)

1. Remove the Jacks, Queens and Kings from the deck.
2. Seven cards are dealt to each player.
3. The remaining cards are placed face down in a 'draw pile'.
4. The top card is placed face up in a 'discard' pile.
5. The player to the left of the dealer is first; play proceeds clockwise around the group.
6. The player may choose the top card from the draw pile or the top card from the discard pile to find addends equaling ten. These are displayed in front of the player.

FOR EXAMPLE:





(As the player displays his/her cards, he/she says aloud the fact or number sentence. e.g. "9 + 1 = 10" "3 + 3 + 4 = 10")

7. The player then discards one unwanted card in the discard pile.
8. If a ten (10) is drawn or the player is dealt a 10, he may draw 2 extra cards and discard the ten (10). (10 may not be used as an addend since there is no zero in the deck)
9. If a player displays groups of addends that do not equal ten, he/she must forfeit the next turn.
10. The game is over when any one of the players runs out of cards in his/her hand. (This is not necessarily the winner.)

SCORING:

Players receive ten points for every group of addends displayed. The winner of the game is the player with the most points.

VARIATIONS OF "TEN":

"NINE" may be played in a manner similiar to "TEN", however, in this variation, the Kings, Oueens, Jacks and tens must be removed from the deck. Pairs or groups of addends equaling nine are found and displayed. Accordingly, the "nine" (9) card becomes the "extra draw" card.

In scoring, players receive 9 points for every pair or group of addends.

"EIGHT", "SEVEN", "SIX" and "FIVE" may be played in the same way. In each of these variations, all cards higher in value than the name of the game must be removed from the deck. Points are scored in a similar manner.

In playing these variations, two decks of cards must be used.

ANOTHER VARIATION:

"ELEVEN" may be played with the Jack as the 'eleven card' which, when dealt or drawn, entitles the player to two more cards. Scoring is then based on eleven points for every pair or group of addends made.

SOME RECENT CHILD-WATCHING EXPERIENCES

Phyllis Susan Smith

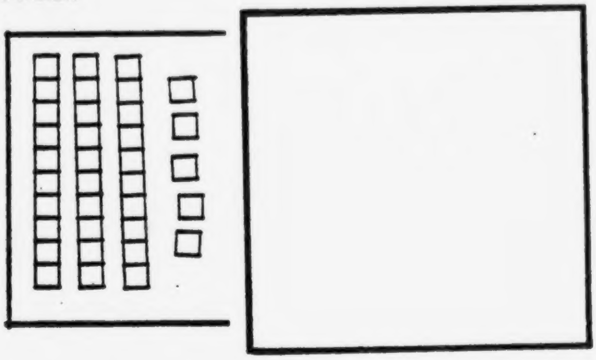
Tasks -- Counting cubes, counting pennies, and number ramble.

Location -- Casa Dia Montessori Daycare Center and friends' homes.

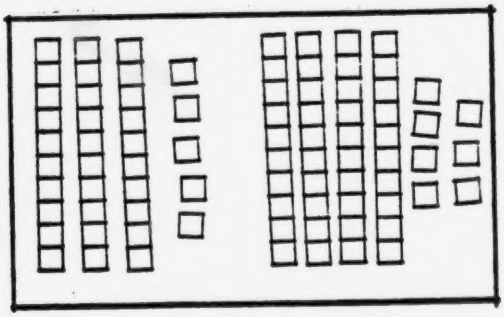
Children's ages -- one - 10 year, two - 11 years, one - 7 years, three - 6 years, one - 5 years.

Description of the three tasks and questions asked:

A. COUNTING CUBES



Q: "How many cubes are showing on the board?"



Q: "How many cubes are there altogether on the board?"

Children's responses:

Chris - age 10

Started with first group of tens and counted number of cubes. He then multiplied by three and added individual cubes to the total. When additional sheet of cubes were added, he took total of first group (35) and went on by adding the group of tens (45, 55, 65) and added odd number to total.

Dirk - age 11

Counted first row (10) added two more rows of ten and added individual cubes. When additional sheet of cubes were added, he added rows of tens then added 5 + 7 (individual cubes.)

Carlita - age 7

Counted each cube individually. Given next sheet, started at beginning counting all blocks individually. Got confused on second sheet and started counting over at the very beginning.

Michael - age 6

Started counting individual cubes (counted from right to left). When second group of cubes were added, he could only count to 39. He started guessing at next numbers.

Melinda - age 6

Turned blocks sideways. Counted each cube individually, but skipped many cubes while counting. When second group was added, she could only count to 49. Started guessing at numbers.

Michael - age 6

Counted each cube individually. When additional sheet of cubes were added, he was able to count all cubes. (82)

Adam - age 5

Started counting individual cubes (counted from right to left).

When additional sheet of cubes were added, he counted to 49 and then skipped to 100. He counted from 100 to 109, skipped to 1000 and counted to 1009, skipped from 1009 to 1,000,000 and counted to 1,000,009.

B. PENNY TASK

Ten pennies placed randomly on a table.

Questions:

Count how many pennies on the table.

(covered some pennies with paper, while the child held eyes shut)

Count the pennies again.

How many pennies do you think are under the paper?

Make up a game, using the pennies, that I can play.

Children's reaction to problems:

Chris - age 10

Counted each penny (would not touch pennies). When groups of pennies were covered, he observrved number of pennies remaining and subtracted that from the original number (10) to get answer. His game for me was to ask how many pennies were on the table heads up.

Dirk - age 11

Counted pennies by two's. When groups of pennies were covered, he observed number of pennies remaining and subtracted that from original number. His game was to ask me, "If you wanted to buy six gum balls and each gum ball was 1c, how many pennies would you have left?"

Carlita - age 7

Touched each penny as she counted. When groups of pennies were covered, she never got correct answer (random guessing).

Michael - age 6

Lined up all the pennies before counting. When groups of pennies were covered, he got correct answer. He was not able to tell me how he got his answer.

Melinda - age 6

Touched each penny as she counted. When groups of pennies were covered, she randomly guessed at the answer.

Michael - age 6

Touched each penny as he counted. When groups of pennies were covered, he got the correct answer (5). When asked how he got his answer, he said, "1 is 6, 2 is 7, 3 is 8, 4 is 9, and 5 is 10."

Adam - age 5

Lined the pennies up and then counted each penny. When groups of pennies were covered, he got the correct answer (5). When asked how he got his answer he held up both hands. He said, "Five (holding out five fingers) and five (holding out the other five fingers) equal ten."

C. NUMBER RAMBLE

(I teach elementary physical education and wanted to make up a task that would incorporate math problems and physical skills.)

On large cards I have written numbers and scattered them all over a large area (for me that would be a gym, other teachers may use an outside area or any area where the kids are free to move).

Questions:

Find a way to move (skip, hop, run, slide, etc.) to any card that is larger than ___ (eg. six).

Now find a way to move to any card that is smaller than (eg. four).

Add or subtract from the number on the second card from the number on the first card and make the answer with your whole body. Example -- Chris skipped first to the number 9 and then to 3. Chris would make the number 6 with his body.

Children's reaction to problem:

Chris and Dirk - ages 10 and 11

Had the older kids work together. Their motor skills were good and they seemed to enjoy doing it together. The problem I gave them had two numbers that changed and they each made one of the numbers. Both worked very well together.

Carlita - age 7

Motor skills were good. Able to make the answer with her whole body.

Michael - age 6

Poor motor skill. Looked for lots of encourgement and approval. Made answer with his fingers.

Melinda - age 6

Would not do this task.

Michael - age 6

Good motor skill. Made answer with his whole body. He said he liked this game the best.

Adam - age 5

Motor skills were limited. It was hard for him to switch from one task to another. Did the problem using his whole body. (reversed 2 out of 3 of the numbers)

PERSONAL COMMENTS:

Children watching has been a real "turn-on" for me. I've talked about my reactions and the kids reactions to anyone that would listen.

If given time children do have extraordinary ways to solve problems. Their creativity is remarkable and a marvel to watch.

I don't have a clear answer to some of the ways that children use to solve tasks, but I do feel I have a better understanding of how their process works.

WATER PLAY

Judith Lyons

Some objects will float on water and some will not. Most pre-schoolers enjoy playing in water and can learn from that play.

All that's needed is a pan or bowl of water and assorted objects made of different materials. Materials can include buttons, pieces of a sponge, toothpicks, paper clips, clothes pins, etc.

Fill a bowl or pan with water. Spread the objects you have collected on the table near the water. Encourage the children to make a prediction and to experiment to see which objects will float and which will not float. Encourage the children to sort the objects according to whether they float or don't float.

A supply of different objects could be provided for the children who are interested.

HOW DO YOU PLAY SOCCER? -- THREE POINTS OF VIEW

Judi Jennetten

Children deform reality. We all do. In order to get acquainted with children's thinking, we have often posed very simple questions, such as "What is a mother?" "What is a pilgrim?" and "Tell all you know about Abraham Lincoln." One response to the latter question went something like this... "Sailed on three ships, first president of the United States, killed in Dallas..." Here is Judi Jennetten's report on one of these "simple" questions: "What is the game of soccer? Tell me all you know about soccer." -- T. C. O'Brien

When I asked the questions, "How do you play soccer?" and "How do you win soccer?" I chose three children at different age levels to allow comparison of thoughts and to observe possible progressive complexity of the game in relation to the age of the child.

Ellen, age five, kindergarten:

How do you play soccer? "With your feet."

How do you win soccer? "I don't know."

I think it's important to note that winning at this age is unknown as are complex rules. Ellen's action is an end in itself. Soccer to five year olds is basically what Ellen said, "With your feet."

Patrick, age seven, second grade:

How do you play soccer? "Kick the ball with your foot and try to get it in a goal. Kick with the side of your foot."

How do you win soccer? "By kicking the ball with the side of your foot and getting it into the goal and getting as many goals as you can."

By this age there is some competitiveness, at least an understanding of how to win the game and (I suspect) a relation between means and end. However, the answer was somewhat egocentric. An emphasis was placed in both answers on kicking with the side of hi foot. This is a skill the child had been recently asked to practice. No mention was made of a team, of an opponent team, of a comparison o scores.

Paul, age nine, fourth grade:

How do you play soccer? "There are eleven players on the field, including the goalie. Is this question, 'How do you play soccer?'" I answered, "Yes." "Hands are not allowed in this game, it's a foot game." At this point he seemed overwhelmed because there is so much to explain. "The object of the game is to kick the ball through the goal."

How do you win soccer? "By the team who kicks the ball through the goal the most and gets the most goals."

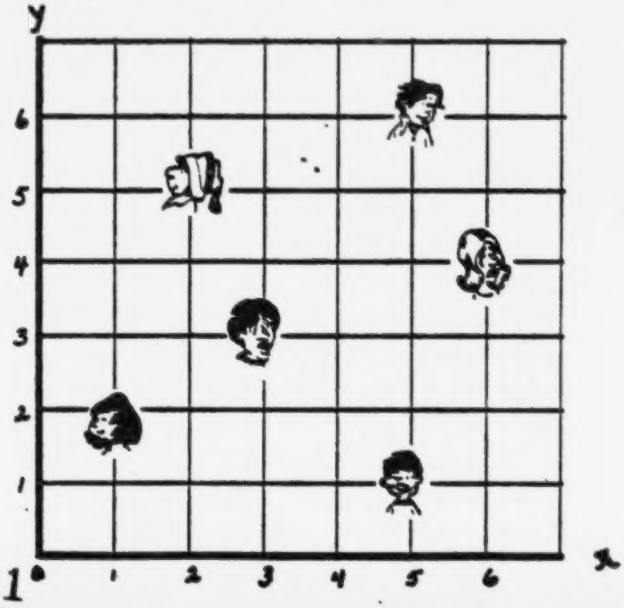
Paul's answer to the first question was much more concerned with technical details than the other children's responses. After presenting some of the rules, Paul sighed when he realized it could b a time consuming process to go through the list of rules with which h was familar. At this point he took a few moments to reflect and then explained, "The object of the game is to kick the ball through the goal." (At this age level rules are important and must be followed. Children are able to understand a more complex set of rules, play in a somewhat cooperative effort with a team, and place more emphasis on winning.)

HUMAN GRAPHS?

Donna Thompson

As we all know, graphs are a way to display information in an orderly and concise manner. At one time or another we have dealt with graphs in practically every aspect of life. But to a young child encountering graphs for a first time bars, lines, and X and Y axes are strange alien beings. In order to acquaint the child with the terms associated with graphs, a teacher can have the students use blocks, graph paper, string beads, or construct a human graph.

What is a human graph? To make one is simple. Push the desks against the walls of the classroom. Then have students mark off positive X and Y axes on the floor (masking tape is useful here.) The students would then place themselves on the axis and they take on the characteristics of that point on the axis. The remaining students are the points of the graph. Game cards are given to the students who are points. The points have to find their locations on the graph. The other students have to write down the location of each point person. In this way, students are acquainted with the graph and develop their skill of placing and finding points on a graph.



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CLINICAL INTERVIEWING

Daniel S. James

Recently, I conducted some interviews with elementary school children. I wanted to observe the way these children use manipulatives to count and do simple additions and subtractions. I was interested in their understanding and use of place value in their overall number knowledge.

The following is a list of the eight children that were interviewed, along with their age and grade level they will be entering. (These interviews were conducted in August, just before a new school year started.)

Jamie, seven years, second grade; Jennifer, seven years, second grade; Chris, seven years, third grade; Krista, eight years, third grade; Laura, eight years, third grade; Ricky, eight years, third grade; Brandy, nine years, fifth grade; Shelly, eleven years, sixth grade.

Before I began each interview I started with small talk to relax the children. They were all excited about the special attention. I explained to them I was writing a paper for school and I was looking for information they could help me with.

I then justified the use of the tape recorder which was to help me remember what they said.

Finally I made it clear that I was not interested in a "right" answer but only how they figured out how they got their answer.

The children were interviewed on two different issues. The first task was counting with a string of beads that changed color after every ten beads. I asked each child if he or she had seen anything like this before. All eight children responded, "No". I asked them again if they had seen it at school and six of them said, "No" again. Chris said he remembered seeing it on a board. I asked him what do you do with it and he said, "You move them around". I asked him, "Why do you move them around?" and he said he didn't know. Laura, a third grader, said she saw it on a chart where beads go across. She said she saw this chart both in first and second grade, but never used it.

It was obvious from their responses that they hadn't done any counting, that they could remember, using an abacus or some type of bead method.

After handing a string of beads to each child I asked them to slide four beads away from the others -- then eight more beads -- then six more beads. I then asked for the total and how they got that answer.

All eight responded with eighteen. My first observation was that not one of them counted out loud. Five of the eight obtained their answers counting by ones. Two regrouped the beads exactly as they were given. Krista grouped by five's and a remainder.

Then they were asked to remove three beads -- then six more. "How many beads are left?" All said nine. The same two who earlier grouped as the question was stated did their subtraction as the question was stated. The same five who earlier counted by ones again counted the remaining nine beads by ones. Krista who developed her own grouping of fives earlier, grouped by threes.

Next I asked them to count groups of ten. The youngest, Jamie, became confused. Still another counted only by ones. Three saw groups of tens. Brandy counted by twos, but then said out loud ten plus ten is twenty. Chris counted only by ones. Shelly, the oldest, said, "Oh there's ten in a thing." Then she grouped quickly. Shell was the only one who could count by tens quickly when asked to count eighteen, twenty-eight, and thirty-eight. Krista again did her own grouping of fives and twos.

This is a vivid illustration that when left to their own method kids usually have a scheme that will lead them to the same answer.

Furthermore, the youngest of the group was not ready for groupin of tens on the ten, twenty, thirty pattern, and the oldest was ready to group by tens on the eighteen, twenty-eight pattern.

Obviously chronological age and mental age are not always the same. The point here is there are different levels of readiness and it is up to a discerning teacher to approach learning at the realist level.

The second task was a place value task using the number 231 and 198. Each child was shown a card with "231" printed on it. Then a similar card was shown with "198" printed on it. The children were asked to name the number printed on each card and to tell which numbe was more.

Six children said "two hundred thirty-one", and "a hundred..." o "one hundred ninety-eight". The other two simply said "two thirty-one" and "one ninety-eight", omitting the word hundred. Seve agreed immediatly that 231 was more. Chris vacillated several times and finally chose 231.

When asked to explain why 231 was more, only the two children wh did not use the word "hundred" when they read the numbers said they were larger "because they were." The six others said, pointing to th digit in the hundred's place, "because the two is larger than the one."

However, one of the six, Chris, who earlier couldn't decide, did change his mind again and decided because the nine and the eight were bigger than the three and the one that 198 was bigger than 231.

I mentioned to them that we could come back to the numbers. We then proceeded to lay Bingo chips on an index card that had been sectioned into three columns. I then had them help me put one in the first column, nine in the next and eight in the last. On the other card two were placed in the first column, three in the next, and one in the last. We then looked at the latter card and I asked them what number this could represent. Six children said "six" because there were six chips. Ricky said, "four." This aroused my curiousity. He said four because the chips were laying in a pattern that resembled the shape of the digit 4. He then said, "six".

With a prompting of "What if we said this was the hundreds, this was the tens, and this was the ones," six said two hundred thirty one. One needed no prompt because she gave this instead of the "six". The eighth child Jamie, the youngest, did not get past this step. He also seemed to tire and really did not participate in the rest of the interview. I might add that the next two youngest needed a lot of prompting. When faced with the other card of chips seven children said, "one hundred ninety-eight."

When asked which of the two cards was bigger three children stated "198", but then changed. They realized, on their own, they were counting chips rather than groups.

Chris still said 198 was bigger because "It's got more than six chips." I might add here that Chris said 198 was the "number on the Bingo chips after a two minute wait period.

The most interesting statement came from Brandy who earlier had stated that 231 was bigger "because it was." Now she stated, after using the chips, "because there are two hundreds here and one hundred here."

CHILDREN INTERVIEWING

Chrisula Skordos

What do you do when you have a newcomer in your classroom/ The children have so many questions and the newcomer feels like an outsider. Let me share with you what one good teacher (the cooperating teacher in my student teaching experience) does. She holds an interview session.

First, the children gather around the person to be interviewed. They get out a pencil/pen and paper. Then someone sets the timer for fifteen minutes. The children fire their questions at the person and take notes from the person's responses. After the timer goes off, th children review their notes for five minutes. Then, they get out a clean piece of paper and put their notes away. The timer is set agai for five minutes and the children write what they remember about the new person.

When the timer goes off, the person who was interviewed reviews the papers and gives each child points for every item correctly remembered.

These interviews serve several purposes -- the newcomer is made t feel important to the group, the children get answers to the many questions they have about a new classmate, the seeds for new friendships are planted and many oral and written language skills are used.

A REVIEW OF JOHN HOLT'S HOW CHILDREN LEARN*

Debbie Hagemeister

This is a very interesting book based on observations of children's thinking from age six months on into school age. It's a book which any parent, teacher or future teacher would find observations they themselves have made of children's thinking and some views on which they disagree.

Some of the views the author explores in his book are:

1. A lot of learning is imitation -- whether it be motor, language, feelings.
2. Children are curious.
3. Children's feelings are related to their surroundings.
4. Children learn by cause and effect -- if A occurs, B will follow.

The areas in which the author focused his views on were Games and Experiments, Talk, Reading, Sports, Art, Math and Other Things.

The ideas that impressed me during my reading are these:

1. Let a child learn naturally, by exploring, watching, and through conversation. That way they will not become discouraged, confused and/or quit trying.
2. If you do not understand WHAT a child is saying, DO NOT give up. Ask him to SHOW you or have another child interpret. The child is trying to say something important. (How often have we ignored a child or pushed him away because WE did not understand or have patience!)
3. Patterns of talk are sometimes nonsensical -- children make up nonsense words, songs because they sound good. (I still do this with my animals' names!)

4. In learning to read, do not force them to learn -- a child can sense an adult who displays a superior attitude. (I am sure we can all remember being insecure about a situation or new concept because of lack of knowledge -- algebra, logic, foreign language Piaget).
5. How often have we listened to a child read a word on one page an then not know it on the next. The author stated not to correct him, because he would correct himself, even go back a page thinking something was wrong. (I found this so in reading today -- two names being mispronounced and I was guilty of over-correction). The idea is to be patient and let the reader use his own "self-correct" skills. Otherwise, the reader may never make judgements about his work but let others do it for hi
6. A child senses if a parent is excited or bored with reading a story. It does not have to be one at the child's level as long the reader makes it interesting! (I have been guilty of this -- reading the same story for the 10th time does bore you).
7. Let a child pick up or ask about a material on his own. He will be more enthusiastic than if ASKED to work with it.

These are only a few of the many ideas/observations shared by the author. You may take a different stand on them than I did, but I fee that you will gain some valuable insight into child watching and thinking.

* Holt, John, How Children Learn. New York: Dell Publishing Co., 1967.

HOW FAR IS IT?

Maggie Burhite

To give children an idea how far a mile (and/or a kilometer is) take a class walk.

The teacher would have to do some advance preparation for this activity.

1. Drive a mile from the school, and note what landmark is at that point, so you'll know where to stop your walk. As you are driving, note what is at the 1/4, 1/2, and 3/4 mile points. If you choose to compare the distance between a mile and a kilometer, note what is at the 6/10 mile point (this is approximately 1 kilometer). If you feel really ambitious make note of what is at the 1/4, 1/2, and 3/4 kilometer points too.
2. You might also choose to drive from the 1 mile point to several different landmarks that are familiar to the children, such as, a library, grocery store, etc. Then when your class has stopped at the one mile point, you can ask them to estimate how far it is from where they are to the library, grocery store, etc. By previously recording the distance, you will be able to tell them right away whether or not they were correct in their estimates.
3. You will also need markers to place at the 1/4, 1/2, and 3/4 mile and/or kilometer points. You could cut pieces of doweling to stick in the ground as you go along. If you are comparing the difference between a mile and a kilometer, you might for example, color the tops of the mile markers red, and the tops of the kilometer markers blue.

Choose a nice day, or any day you're in the mood to walk a couple of miles with your class! As you walk along, stick the markers in the ground at the different points mentioned above. You might ask the children to estimate about what point they think they're at as you go along. When you reach the one mile point, sit down and relax and discuss the distance walked. If you want to, you could time the walk. As such questions as, Is a mile longer or shorter than you thought it was? How about a kilometer? If it took us twenty minutes to walk one mile, walking at the same pace, how long would it take us to walk three miles? At this time you would also ask the children to estimate the distances from where they are to the library, grocery store, etc. On the way back to the school, the children should be able to tell by the markers how far they have gone and how much further they have to go.

When you are back in the classroom, you might follow-up this activity by having the children record any observations they made during the walk.

You can conduct this walk many different ways. You may choose to just walk a mile, just walk a kilometer, or combine the two. You may also choose whether or not to use quarter mile markers.

THE BROWN-EYED GIRLS AND THE UGLY AMERICAN

Margaret Gilligan

Jan was a lovely litle girl, eleven years old, with long curls and a pretty complexion, but her most noticeable feature was her beautiful brown eyes. Those eyes continue to haunt me, for all too often as I looked at her they were filled with frustration and bafflement. Every day as our sixth-grade classes shuffled and regrouped for math and reading, she and twenty-five other students (ranked as next to lowest in ability) came to my classroom for their daily struggle with the mysteries of math. And struggle we did. I was inexperienced in classroom teaching in general and especially insecure in the world of math, but I doggedly "taught the textbook", ground out stacks of worksheets, and went over the material time after weary time. But no matter how hard I tried, all too often Jan could not follow. I might as well have been speaking to someone who understood no English at all. In the time-honored fashion of the Ugly American faced with such a situation, I spoke louder and slower and with gestures but kept repeating the same unintelligible noises over and over. And those baffled eyes kept staring up at me.

I came to understand that Jan was completely unable to cope with the basic abstractions of mathematics. She had blindly memorized some number facts and a few operations and recognized certain configurations of numbers. When faced with math problems she called up her litle arsenal and attacked blindly. This approach would sometimes get her a barely passing score on the simpler problems involving addition, subtraction and multiplication. But division was discouraging, rounding and place value hopeless, and decimals and fractions seemed doomed to remain totally beyond her reach. As those eyes seemed on the verge of tears, I sought help from other teachers, to little avail. Finally, I took the time-honored course and had her transferred to the lowest group, where they spent a lot of time coloring.

One year later, with the memory of my frustrations and feelings of failure still painfully fresh in my mind, I encountered the ideas of Piaget and the varied and imaginative resources of the Teachers' Center Project. In the pages of The Piaget Primer I met Jan and her classmates again, but this time with explanations of where they were coming from and why I had been unable to meet them halfway. Here too was an explanation of the maddening phenomenon of the thoroughly taught and completely covered material that seemed to "take" one day yet become unstuck the next. As we engaged in the child-watching tasks I came to get some glimpse of how my students think and how they differ from adult ways of thinking in general, and my ways of thinking in particular. As these ideas began to creep into my questioning and listening behavior, I began to understand them even better. In their activities, my students so often demonstrated their complete unawareness of the contradictions and lack of consistency in their thinking and their performance. I realized that they have built up a store of memorized facts and techniques handed down to them on a tablet by an array of teachers and accepted on their authority only. Down deep inside they don't know but that on some different day, with some different teacher looking on, two and two just might equal five.

But with a snowstorm of insight fragments, philosophical seeds, and games, gimmicks, and gadgets whirling about in one's head, where do you begin? Then one Saturday it was my job to help break in a new employee in our family's small retail store. She was an attractive young woman, a freshman at the junior college, friendly, alert, and eager to please. She could manage the mechanics of making change, writing sales tickets, and operating an older-style, non-electonic cash register. But problems arose when she was required to use different measuring devices and units of measure. Accuracy in following detailed directions, or in writing clear directions for others to follow also proved quite difficult for her. As we struggled along, I suddenly looked up to see what I hadn't really noticed before--her pretty brown eyes, and her look of frustration. Startled, I realized that I was once more on the verge of doing my ugly American routine again. I backed off and began asking questions to find out more about her thinking and understanding so I could devise ways of helping her. In our conversation, I had to have her complete an income tax withholding form. She did not know how many exemptions to claim. I asked her what she had done in her previous job, and she replied that the supervisor had just filled it out for her, because she didn't understand it. Later, when we had to prepare a package for mailing to a customer, she had many questions, revealing that she had no idea how one goes about mailing a package. (She asked me how she could send some cookies to a friend away at college at the same time.)

As we talked and worked together I realized how much she lacked in hands-on experiences at so many levels, despite the fact that she had been a "good student" in high school and was doing well in her current school work. I began to see where and how to begin with my students--looking everywhere for ways to give them more of the kinds of experiences and activities that will help them understand and grow instead of handing down more tablets of facts.

Labinowicz, Ed. The Piaget Primer. Addison-Wesley Publishing Company, 1980.

WOW!!! SPANISH IS EASY!

Vito Benivegna

This is a suffix-related language activity that can be used to show the great common ground between English and Spanish. It can be used with all youngsters, but the younger they are, the more effectively it works.

Without any preparation, I normally ask the children to provide me with an English word ending in -tion. We then compile a list of these words as in column (A) below.

I repeat the English word and the corresponding Spanish equivalent. Then I ask them to repeat the Spanish word that they have not seen before.

(A) ENGLISH	(B) SPANISH (orally)
attraction	atraccion
action	accion
lotion	locion
distinction	distincion
composition	composicion
destruction	destruccion
emotion	emocion
fraction	fraccion
application	aplicacion
portion	porcion
creation	creacion, etc.

This repetition drill makes the obvious relationship between the English-Spanish suffixes: -tion and -cion. There are literally hundreds of words of this type.

More words can be added in Spanish which usually results in the voluntary chiming in to repeat them. Sometimes the youngsters will even give the English counterpart without being prompted. The exciting aspect of this activity is that they can usually provide words in English that they have not heard or seen before.

This activity can be extended to other suffix relationships between the languages:

ENGLISH -ty	SPANISH -dad
clarity	claridad
unity	unidad
barbarity	barbaridad, etc.

ENGLISH -ly	SPANISH -mente
serenely	serenamente
generally	generalmente
recently	recientemente, etc.

These activities can foster lively, thinking sessions. Usual student reactions are: "This is fun. When can we do this again?"

A WINDOWSILL PARADE

Pat Potthast

Ask each child (or small group) to make a "float" for the "Windowsill Parade." They can use shoe boxes for the bases of their "floats." Each "float" should convey an idea or concept about a particular event or happening. For example:

1. an event from the Civil War period
2. a person who invented something
3. a scientific concept such as water in its various physical states
4. a mathematical concept depicted in story form
5. a reading story or a particular character from a story
6. etc., etc., etc.

CHILDREN'S NUMERICAL THINKING

Susan B. Roberts

The idea of studying children's numerical thinking is the basis for this project. To analyze this thinking eight children in fifth and sixth grades were interviewed. Three of these children were girls (Jenny -- sixth grade, Christa -- fifth grade, Alexis -- fifth grade) and five of them were boys (Chris B. -- sixth grade, Chris L. -- sixth grade, Pat -- fifth grade, Sam -- fifth grade, and Brandon -- fifth grade). These children were asked about three math problems. After each child had given an answer to each problem, I asked questions about the process involved in reaching that answer.

First, each child was asked to compute the answer to the problem 28 + 57 = ?. I placed the problem written on paper, in front of each child and asked him to work the problem. All eight were able to arrive at the correct answer quickly with the use of pencil and paper. I then interviewed each child to ascertain his/her understanding of what had been computed. All eight were able to explain that 8 + 7 = 15, and they had carried the one and added that to the 2 and 5 to get 8. Three further explained that the one stood for the ten that was left over when they put down the five for fifteen. The difficulty came with others in explaining why they had carried the one. Four were able to explain that the one stood for ten but could go no further when asked why it stood for ten, one of the four saying, "I just learned it in school." The last could say no more than the one "just stands for one."

In characterizing the thinking of these eight children, it was clear that only three understood the concept of carrying. The other

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five could compute without complete comprehension. The interview method clearly revealed the exact nature of the problem. Its implications should help a teacher to realize the shortcomings of paper and pencil computing as compared to a true understanding of this computation.

The second problem was one that I created. I stated to each child, "The answer is $9.00. What is the question?" All eight were able to give me a correct answer as far as computation. Of the eight, six gave me a simple addition or subtraction problem (i.e., $10 - $1 = $9.) Two of them gave me story problems without questions. One of these two had to rethink her answer as follows:

Christa: I have four apples and I bought five more.

Interviewer: Let me repeat my answer. The answer is $9.

Christa: Oh, no, I made a mistake. I have $8 and I earn a $1 for the dishes.

The second responded with a problem similar to the latter one:

Chris B.: Like make up a story.

Interviewer: Whatever you think.

Chris B.: A kid bought a hat for $6 and a book for $3.

In characterizing the thinking on this problem, all eight were able to answer quickly. (Perhaps I should have chosen a double-digit number. It might have revealed more of the thinking process.) In all eight cases, the children did not pose a question. They merely gave a problem in which $9 would have been the answer if a question had followed the figures. My problem did ask for a question. It would be hard to determine exactly what the listening or thinking problem was that was at fault. The quick response that was given for this problem was in direct contrast to the slow response that was given for the problem that follows. The problem that follows was also a reversal problem that required the same type of thinking.

This last problem was a similar problem to one studied by Thomas O'Brien and Shirley Casey. For this problem, I had written on a shee of paper, "Write a problem for 8 + 6." As I stated above, the response to this problem was slow. Three of the eight after approximately two minutes of deep thought could not figure out a stor problem:

Pat: "I have no idea."

Christa: "If I had just ended school, I could figure it out, but I can't now."

Brandon: "I'm stuck and can't think of one."

Alexis and Sam both had a similar format for the story problem, but Alexis did not ask a question:

Alexis: "their was 8 plums and their was 6 cherrys"

Sam made his story the same type of brief computation, but he did have a question:

Sam: "8 girraffs and 6 elephants equals what!"

Jenny and Chris B.'s answers could be grouped together as both of these sixth graders did write a story problem with the appropriate facts and questions:

Chris B.: "A guy in school had to find out how many people where in the class. There were 8 Boys, and 6 Girls, How many in all?"

Chris L.'s problem revealed a superior understanding of story problems as well as an advanced ability to deal with a more complex type of story problem:

Chris L.: Mary went to the store one day. She needed

> socks and toothpaste. The socks were 2 pairs for $3.00. The toothpaste was 3 tubes for $4.00. If Mary bought 4 pairs of socks and 6 tubes of toothpaste, how much did she spend?

As far as the implications of the results on this reversal story problem, they reveal that a majority of these children do not understand the fundamental thinking behind a simple number sentence. While every one of these eight children could compute 8 + 6 = 14, most of the eight could not place this arithmetic in a logical situation that would reveal a use for the 8 + 6. Yet realistic problem situations will be a part of everyday life outside of the classroom. In life it will be necessary to employ mathematical thinking before using the actual addition, multiplication, division and subtraction. Yet these results reveal a lack of basic mathematical reasoning which should come before computing.

In conclusion, through interviewing and listening to eight fifth and sixth graders, I can appreciate the importance of these children's understanding of mathematical concepts behind actual mathematical computations and problems. This method of listening and questioning revealed a lack in their logical thinking, for the most part. It also revealed the wide range of differences in their understanding of problems. This interviewing provides the teacher with a tool for diagnosing mathematical problems.

THE GRADING SYSTEM -- DUCK SOUP?

Maggie Burhite

Two little ducks that I once knew...a fat one, a skinny one, there were two. One day, Mama Duck called her darlings to her side and said, "You are five years old today...lick your feathers and waddle off to duck school. It's time you learned how to swim." Dame Duck looked at her class of little ducklings and announced, "In order to get an "A" in duck school, you will have to demonstrate the proper swim form for all little ducks your age." Off to the pond they went. Fat Duck jumped in the water and paddled around happily, feeling very good about himself. "No! No!" shouted Dame Duck, "Your tail is almost underwater. That's not proper form." "But I can swim faster and I feel better with my tail down," said Fat Duck. "No matter," said Dame Duck, "it's just not done that way." So Fat Duck struggled along in the water, using proper form. Dame Duck smiled and said, "That is good." Then Skinny Duck jumped in the water, skimmed along the top and squealed, "This is fun!" "Stop!" yelled Dame Duck, "Your feet are not down far enough. You are not using proper swim form." "But I can swim faster with my feet to my chest," he protested. "You will fail if you do not correct yourself," Dame Duck cautioned. With a sigh Skinny Duck, too, complied with Dame Duck's wishes. Mama Duck was proud of her two "A" student ducklings. "Go out and celebrate with a morning swim," she said. Shortly after entering the water, the two ducklings saw hunters approaching. "Swim! Swim!" they yelled to each other. Both struggled across the pond in proper form. Bang! Bang! "Well," said one hunter to the other, "Looks like duck soup tonight!"

OBSERVING HAS ITS BENEFITS

Becky Crews

Observing children's thinking is something that can be incredibly beneficial for you as a teacher and for your students, too. Recently I have had many chances to observe children and teachers. The benefits are really great. If teachers could only be observers of their own classrooms for a day or two, they would see their students in a different way. They would find better ways to go about helping their students in the learning process. I would like to share some of my observations with the hope that teachers will consider taking time to find out what's really happening with some of their students. I observed the entire fourth grade class but the most shocking observations came from the children people call slow learners.

A fourth grade boy in the class I observed would very seldom do any work unless told what to do each step of the way. The really sad thing about this was that the child was repeatedly receiving "F's" because he would not turn in his homework. Why didn't he turn in his homework? The obvious answer did not apply. The obvious answer was that he doesn't know how to do this or that particular task I took the time to watch him closely one day. I asked him to get out his paper and write down the first problem, which was: 34 - 18. He said he didn't understand how to do the problem. So, I asked him what he thought we should do first. He began explaining everything to me correctly without hesitation and finished the problem. The answer was correct. I encouraged him to continue. He worked a few more problems and quit. The answers to those problems were correct. But since he rarely finished his work he received "F's" and therefore gets those grades on his report cards. My concern is that children like this b are being treated incorrectly because the time is not being taken to observe children in detail.

I observed a second boy also in the fourth grade. He hadn't finished his homework that day so the teacher made him finish the assignment in the room while the rest of the class discussed and graded their homework problems. I watched as he worked. The proble were on column addition. Even with all the noise and distractions i the classroom, he finished the page of problems in a short amount of time. He had five imcorrect answers which was an average number of errors for the class on that assignment. These boys understood how do the work. It just didn't appear that way because they did not tu in homework that day. Perhaps answers to why they did not turn in their homework when they knew how to work the problems would be interesting.

If teachers could be observers in their classrooms for a day (while a substitute or another teacher taught), they could have a chance to ask questions and work with children that they normally judge there is no time for in a regular day. I suspect such a day could be an enlightening experience.

Editor's Note: How often does a child receive a poor grade because (s)he didn't or wouldn't do the assigned task rather than because (s)he couldn't do it?

How often do we when we read a child's grade assume that it is a record of what the child can do?

SCHOOL -- A POSITIVE ENVIRONMENT?

Debra A. Fagan

How many adults would show up at work every day if they hated their job? I imagine that most of us feel that our work takes up enough of our time that we should be happy and be comfortable with the people that we work with. I imagine the same is true for children. After all, school is their job, and if they are miserable they won't care to show up either!

We, as educators, have a multitude of responsibilities. It is our duty to make school exciting, and to create in the students the feeling of being a part of something good and worthwhile. The total environment, every minute detail, reflects on our students. They notice our appearance, our manners, the general up-keep of the rooms, are they neat or dirty, and most of all -- do we enjoy working at school.

What about the room that students spend most of their time in? Are they allowed to decorate it? What happens to all that paper work that nobody sees anyway? If students share this attitude, it is probably because their work is not on display for anyone to see. Students need to feel that adults and parents, not to mention their peers, like to see the work that they have put concentrated efforts into. They need to feel that it is important enough to do the best they can, and that after those efforts have been put forth, someone will take the time to read -- to notice their work.

Adults receive pay raises as incentives to produce their best work. What kind of incentives do we offer children?

1973

WHAT DOES TILLIE LIKE???

Vito Benivegna

Here is a classification-related activity that my wife and I have been playing with children for many years: "Tillie Williams."

Tillie is a good listening and thinking device that can be utilized whenever you have a few moments between classes.

Suggested procedure: The teacher is the only member of the Tillie Williams Club and she entices the students with clues to solve what Tillie LIKES and DISLIKES so that they, too, can strive to become members.

The key is: if the student guesses the LIKES and DISLIKES of Tillie, he or she communicates this to the teacher with additional, corresponding clues. Thus the game can be sustained for a long time with benefits for everyone. I will give the solution after a sampling of clues.

A few examples are:

Tillie likes	she dislikes
berries	melon
apples	pears
butter	margarine
coffee	tea
kittens	cats
puppies	dogs
giraffes	elephants
calls	telegrams
letters	notes
yellow	green
slippers	shoes
lettuce	tomatoes
football	golf, etc.

The obvious solution is the reference to words that have a double consonant.

This activity may be taken and extended in many directions with math and language. It is fun, it holds their attention, and it fosters thinking. Good luck!

KINDERVILLE

Debbie Buffington

Last year was my first year of teaching and to say that I was little scared and apprehensive would be putting it mildly. I teach kindergarten in a little Catholic school in Staunton. I attended this same school as a child as did my mother and her mother.

When I started preparing for the beginning of the school year, I discovered that the only formal textbook used was the Houghton Mifflin language book. The remainder of the curriculum was made up of handouts and numerous other activities and materials that the former teacher had developed and compiled over the years.

I basically followed my predecessor's curriculum outline with some exceptions here and there. In the area of math, we began the year by reviewing shapes. Most of the children had had this material in pre-school, and those that hadn't attended pre-school were still fairly well acquainted with the basic shapes. Instead of just looking at shapes on paper or on the board, I decided to carry the process one step further. I wanted to give the children some manipulative activities so they could actually get their hands on the different shapes they were seeing on paper. To help accomplish this, I decided that we should build a town.

We called our town Kinderville and constructed it on top of a large fold-out table set up along one wall of the room. I asked the children to start saving all different types of boxes and food cartons and soon our collection was large enough to start building.

The children worked in small groups of two and three depending upon what they were interested in building. I first asked them what

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types of buildings could be found in a town. Some of the responses were general such as houses and stores. We then started to get more specific. Some of the children started to name buildings that their parents worked in. One little girl said she would like to make a barber shop because her daddy had a barber shop downtown. Another little boy wanted to build a hospital because that's where his mommy worked. The ideas were popping up like flowers.

Our construction began. We soon ran into a problem with the empty oatmeal containers. What could we make out of these cylinder shapes? I asked the children if there were any structures in Staunton with this shape. I'm afraid that all I got were bank stares. I posed the question of what could be put into such a shape. I was expecting some of the children who live on farms to recognize this shape as a silo, but to my surprise no one made any comments. I finally asked the children if water could be stored in such a container. They thought this was a great idea and so our cylinder shapes became the Kinderville Waterworks.

Some of the small square boxes were made into such things as a barber shop, a dress shop and the police station. We used the larger rectangular shoe boxes to make a K-Mart and the fire station. The largest boxes were saved for the hospital, school and the church. I was very tickled to see the two boys working on the church start stacking smaller boxes on top of the large box to create the effect of a steeple. To top things off they constructed a cross out of popsicle sticks.

Several of the children had brought milk cartons, and they too posed a problem. Somebody mentioned a hotel so two of our milk cartons were converted into hotels. The children thought the top part of the carton was just right for a roof.

I gave the children a variety of colored constuction paper with which to decorate their buildings. I also allowed them to use pencils, colors and markers to draw windows, doors, bricks, etc. Some of the designs were amazing...bars on the police station windows, stained glass church windows, a red and white striped barber pole just to mention a few. One thing that really interested me was an empty spool of thread on top of the hospital. When I questioned its purpose, the two little girls working on it told me it was there so that the helicopter knew where to land.

I was very proud of our little town even if it did look a little patched and delapidated in places. The children were also exceedingly proud of their accomplishment, and several of them brought their parents into the classroom to see their particular contributions to the total effect.

I think this activity accomplished a number of things. It gave the children an opportunity to work with shapes and to compare sizes. They had to consider such factors as the design of the buildings, how much space was needed on the table, and where should their building be placed in relation to the other buildings. They also had to handle a variety of materials...scissors, glue, markers, colors, etc.

Once again this year my kindergarten class will be building a town, and I can't wait to see some of the new creations that will evolve.

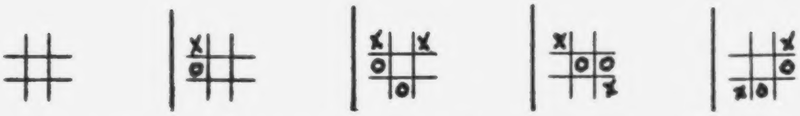
Editor's Note: The reader might also be interested in "City Planning" by Kay Haas on p. 41 of SEEDBED 2. This article describes work her first graders did on planning a city.

1977

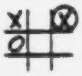
EXCERPTS FROM CHARACTERIZING CHILDREN'S THINKING

Nancy M. Cole

TIC TAC TOE



QUESTION ASKED: If you are "X", what would be your next move? Why?

It seems apparent that the thought processes of the individual children which I interviewed, using the above TIC TAC TOE task, were similar in their anticipation of future moves. However, it was interesting to note that in planning their future moves they often did not take into consideration their opponent's (O) strategies and moves. In a situation such as this,  , the majority placed their "X" (circled) with the idea that this would give them a "sure win" on their next move, ignoring the fact that "O" would probably block their move.

Lynn, age 11, was especially determined to control every move, including those of her opponent (O). She would indicate her move, then proceed to tell me where "O" would move and finally where her then winning move would be. She seemed to be the only one who consciously and verbally played both roles. However, in doing so, she lost track a couple of times of "sure wins" (#3 and #5) and completely overlooked the block on frame #4. Here it is interesting to note that only half of the children blocked the "O" in frame #4. (These included a 7 year old, two 8 year olds, and a 10 year old.) Both the 11 year olds missed the block completely and never did see it, even with further questioning.

The majority of the children recognized frames #3 and #5 as "sure wins" and played accordingly, without hesitation. Two of the eight

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children (a 10 and an 11 year old) missed the "sure win" and when questioned further, did not pick it up.

This task of TIC TAC TOE provided a rich arena for child watching. I found myself really keying into what the child was thinking. I enjoyed the opportunity to really listen, not for the correct "textbook" answer, but for their interpretations and reasons for thinking the way they did.

COUNTING MONEY

Two rolls of 50 pennies TOTAL = 100 pennies

Two rolls of 50 pennies plus 4 single pennies TOTAL = 104 pennies

Two rolls of 50 pennies plus 4 single pennies plus 1 roll of 50 pennies TOTAL = 154 pennies

Two rolls of 50 pennies plus 4 single pennies plus 1 roll of 50 pennies plus 1-50c coin TOTAL = 204 pennies

Two rolls of 50 pennies plus 4 single pennies plus 1 roll of 50 pennies plus 1-50c coin plus 2 single pennies and one nickel TOTAL = 211 pennies

4 single pennies plus 1 roll of 50 pennies plus 1-50c coin plus 2 single pennies and one nickel TOTAL = 111 pennies

QUESTION ASKED: How many pennies do you see? Tell me how you got your answer.

Later revised question to ask: How many pennies do I have altogether in this group? (I used my hand to encircle the area I wanted.) Tell me how you got your answer.

(Steve, age 11, was the first child I interviewed. After his response to my question, "How many pennies do you see?", I rephrased my question for the remaining interviews.)

1979

Using rolled pennies and loose change, I interviewed eight children in order to observe their thought processes when counting the amount of money in a given pile.

There were four children who specifically relied on memory as I presented each new pile of money. Bobby, the youngest at 7 years, seemed to use the previous knowledge to help answer questions for piles #2 and #5. The other times he counted by 50's. Beth, age 8, though her answer was wrong in frame #1, still used this knowledge to answer the amount given in pile #2. Lynn (11 years), being one of the oldest, seemed to rely on her knowledge of previous piles to help her only for piles #4 and #5. Tracy (10) was the only child who consistently and accurately used her memory to calculate the correct answer for each consecutive pile of money.

I found it interesting to note that Steve (11), who seemed to struggle with details in frames #1 and #2, was the only one to express his computation in terms of multiplication. Also, Tracy (10) was the only one who used a subtraction process when I physically took away 2 rolls of pennies. The others continued the same process by which they had started (adding, or in Steve's case, multiplying).

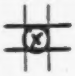
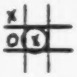
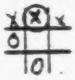
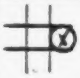
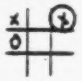
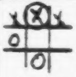
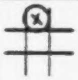
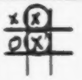
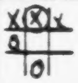
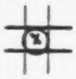
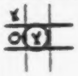
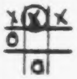
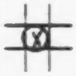
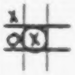
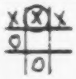
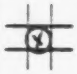
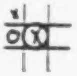
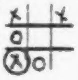
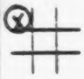
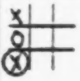
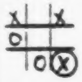
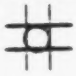
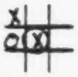
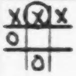
Jackie (8) and Beth (8) seemed to have a difficult time "tuning in" to this exercise. Jackie never really caught on to what I was asking until the last problem. At first she counted in terms of two whole rolls of pennies, but soon lost track of the two rolls when I added 4 single pennies. Then when I added a third roll, she gave me a total of 7 (3 rolls and 4 individual pennies). By the 4th pile of money, she was ready to include each individual penny in the wrappers, but came up with a total of 1900 pennies. She could not explain in detail how she got the "1900", except to say that she counted them.

When the half-dollar was brought to her attention, her total increased to 3300. However, in the last pile of money, when I removed the 2 rolls, she immediately added "50c + a half-dollar = $1.00 + 5c + 2c + 4c = $1.11".

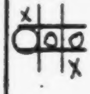
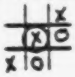
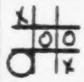
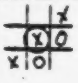
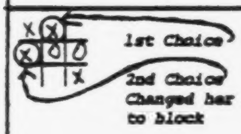
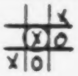
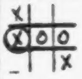
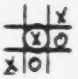
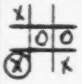
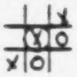
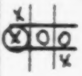
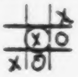
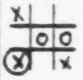
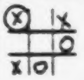
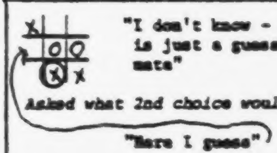
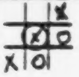
This brings me to another point of interest. By the last pile of money, five out of the eight children had expressed their answers in terms of dollars and cents -- and they were the five youngest children. Bria (10) was the only one to use dollars and cents consistently throughout the questioning. Most would alternate between giving me the total amount of pennies and dollars and cents.

I found this exercise stimulating and I believe that money counting is a powerful tool for gaining insight into how children are thinking. I plan to revise it for my 6th grade class and use it, plus several others that are in the process of being devised, as a way to get to know the kids I am teaching this year.

RESULTS OF TIC-TAC-TOE TASK

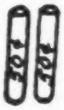
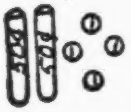
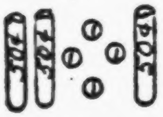
	3/8 chose middle	All moved for the possible win next time	All but 2 went for win
BOBBY 7	 "because you could go diagonal - all directions"	 "because you need one more down here to win"	 "I win"
JACKIE 8	 "I don't know ... I guess to win"	 "... Then I'd have one more place left to put an X"	 "So I'd win"
JULIE 8	 "... cause I could go on down"	 "either here or there-Top one would be better cause other person could go straight across. I'd win though cause I'm first"	 "I'd win" *Quick Response*
BETH 8	 "Cause I can win anyway"	 "So I can stop the 0 from going across"	 "I win!"
BRIA 10	 "I can win all different ways"	 "So I can win diagonally"	 "Then I'd win"
TRACY 10	 "You have more ways to move and it stops the 0"	 "... if I had one more move, I would put it down here and win and it would stop the 0"	 "to stop the 0 from going across and help me go diagonally"
LYNN 11	 "... So I could put my X there, they put their X here and then I put my 0 there" *Note Switch; X - 0*	 "So they would put their 0 here and then here, then I win"	 "First of all I wouldn't do that *(Asks What)* I wouldn't start with those X's and 0's like that! They'll put their 0 there, I win either way"
STEVE 11	 "I can block all diagonal shots. All the shots they can make are straight lines.	 "I can play up or down - gives me 2 chances to make 3 in a row"	 "Because I'd have 3 in a row and win"

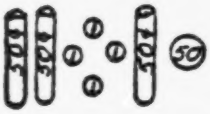
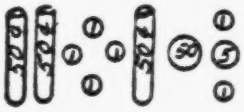
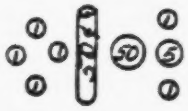
1982

4/8 blocked - defense	7/8 went for win	
 "... to block, so you can't win"	 "I could win"	*Bobby went for win and block each time.*
 "I'd have one place to win there and another one there"	 "I'd win"	*Uncertain of moves, disregarded O playing in #2 and #3.*
 *1st Choice* *2nd Choice* *Changed her mind - to block*	 "I'd win"	
 "Block the O"	 "I won"	*Went for win and block.*
 "Now I can win that way (↕) and that way (↔)"	 "I'd win"	*Missed block in #4, future wins.*
 "... cause it stops O from winning and helps me win - In fact, I'd win automatically"	 "I would win"	*Missed win #3, blocked in #4.*
 "So I win either way - is that what everyone else said?"	 "So I win either way - Oh no, I messed up - I'm so stupid - Can I change it to the middle so I'll win?"	*Every move she decided what both X and O would do so she'd win each time.*
 "I don't know - this is just a guessti-mate" *Asked what 2nd choice would be* "Here I guess"	 "I have 3 in a row and win!"	*Missed block in #4.*

1983

RESULTS OF COIN TASK

NAME	*AGE*			
BOBBY	7	100 - (50 + 50 = 100) *(No hesitation - Quick)*	*No hesitation* 104 (There are 4 pennies and 100 pennies. 100 + 4 = 104.)	*moved 3rd roll next to other two* (50 + 50 + 50) 154 (50, 100, 150) *Now pointing with fingers* (151, 152, 153, 154)
JACKIE	*8*	2 - Cause there are 2 sets of pennies	4 (Cause there's 4 pennies) *Points to them - ignores 2 rolls - Asked her if any more* NO	7 (Because there's 3 sets of pennies and 4 pennies = 7) *She asked do you want all this time?*
JULIE	*8*	*50¢ Pennies 50¢* Label asks - Is there 2 things of 50 in each roll? Total = 100 (50 + 50 = 100)	104 *(Touched 4 pennies)* 50 + 50 then add 4 = 100	*Asks,* "Is this third grade stuff?" 154 *(Touches pennies)* (50 + 50 + 50 = 150¢, add 4¢ = 154)
BETH	*8*	50 - I looked on the label! *Asked how many altogether?* 75 - cause I remember it from school	79 *(remembered 75)* *Counted 4 pennies by touching*	95 (75 + 50, No, it's 85 + 4 pennies . . . 86, 87, 88, 89.)
ERIK	*10*	$1.00 worth (50¢ + 50¢)	$1.00 worth and 4¢ (I added 50 + 50, then 4)	$1.54 (Added 50 + 50 + 50 and 4)
TRACY	*10*	100 (50 in each one, so 50 + 50 = 100)	104 (I had 100 and added 4)	154 (I had 104 and added 50 to it)
LYNN	*11*	100 (50 + 50)	104 (50 + 50 + 4) Of course!	154 (50 + 50 + 50 + 4)
STEVE	*11*	2, 100, 2 wrappers = 102, two words pennies, 1 word on each wrapper *Took question literally - details.*	4 3 are tails up and 1 is heads up - it says "In God We Trust" 1971 D *Lost total of 2 rolls*	154 (3 X 50 = 150 plus 4)

		
$2.04 (50c is same as 50 pennies, so 2 rolls = 100 and 1 roll plus 50c = 100. You get $2.04)	211 (200 + 6 pennies + 5c = 211)	$1.11 (50 + 50 = 100 and 6 + 5 = 11 so you have $1.11)
1900 (I counted all the pennies in the package and added 4 pennies) *Forgot 50¢ - Asked about it* Total would be 3,300 I guess!	40 hundred - 100, 115, 116, 117, 118, 119 . . . 150, 162	$1.11 (50¢ plus half dollar = $1.00 plus 5c + 2c + 4c = $1.11)
204 (50 + 50 = 100 and another 50 + 50 so 2-50's + 2 50's would be 200 + 4 = 204)	211 2-50's + 2-50's = 100 and another 2-50's = 200 + 5c plus all 6 pennies = 211.	$1.11 50 + 50 + 11 = $1.11
$1.25 (89 + 50 = 100 then left over change is 25c probably) *She laughs*	$1.25 + 5 + 2 = $1.32	$1.00 (50, 51, 52, 53, 54, 56 = $1.00) *She laughs and says* I keep getting mixed up, 50 + 4 = 54, 56, 59, 40 = 41 41 is the answer
$2.04 (50 + 50 + 50 + 50 + 4 = 204)	$2.11 (50 + 50 + 50 + 50 + 6 + 5)	$1.11 (50 + 50 + 5 + 6)
254 (Wait, I mean 204. I'm not sure) *(Points)* ($1.00 here + $1.00 here=204)	211 (I had 204 and added 7)	111 (You took away 100 so there's 111 left)
$2.04 (150 + 50 + 4)	211 I think *Hesitates* 200 + 11, yes that's it	111 $1.00 and 11 c = 111
204 ½ dollar = 50c, 50 X 4 = 200 200 + 4 = 204	*Hesitates* 111 - 3 rolls = 150 + 50 = 200 plus 5c = 205 + 6c = 211	111 2 X 50 = 100 and 5 + 6 = 11 = 111.

1985

LET'S INVOLVE SENIOR CITIZENS IN OUR SCHOOLS

Debra A. Fagan

The economic crunch of the 1980's presents us with many problems in our schools. Many schools are faced with cuts in children's educational programs as a result of diminished school budgets. Staf cutbacks, larger classes, reduced individualized attention for students, all are realities that our school systems have to face as result of the economic crunch. In order for schools to survive and still be effective learning institutions, we must explore new approaches to ensure the richness of our children's educational experiences.

A new approach that can solve several of our school ecomonic problems, would be to involve senior citizens in our schools. Children need both individualized attention or tutoring, and one-to-one relationships. An older person might also serve as a grandparent model, especially for those students who do not have grandparents that are living. Senior citizen involvement in our schools can also be a great help as chaperones for field trips, helping with school parties and fund raising activities, and serving as a major link in building community ties with our schools.

Most average families of the 1980's have both parents active in the work force. It follows then that most parents are not available to help with school programs. Many senior citizens would not like t retire from the world entirely, but perhaps have too much time on their hands and would like to devote their talents and interests to something that is worthwhile. Senior citizens have years of experience and knowledge, so why not put all this to good use, especially during a time when our schools are crying for survival. New approaches must be explored, if we are to offer our children the best guidance and learning experiences possible.

Editor's Note: Current research indicates that contact with children is also beneficial to older people.

PICTURES AND SIDES

Bonnie Wagahoff

This activity provides the child with additional experience with flat shapes. It focuses his attention on the concept of sides. He is given practice in the following: Identification of line segments, counting, matching sides with numerals, manipulation of flat shapes, and construction of more complex flat shapes.

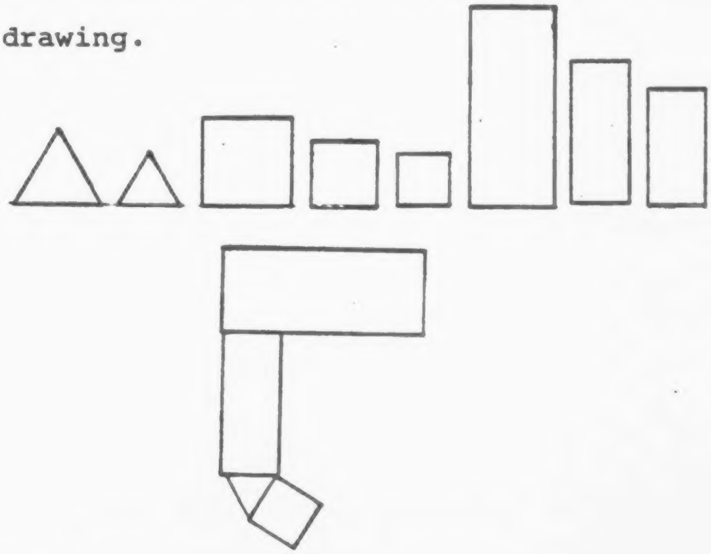
Materials:

2 sizes triangles, 3 sizes squares, 3 sizes rectangles -- cardboard shapes, pencils, crayons, white 9" x 12" paper.

Directions:

1. Use the flat shapes to make three different figures.
2. Draw around the figures.
3. Count the number of sides on each figure and write the number on your drawing.

Example:



Questions to Aid Evaluation:

1. What shape did you make and how many sides on each one?
2. Run your finger around the perimeter of the shape.
3. How many flat shapes did you use in each picture?

Extra Activities:

1. Describe a shape in such a way that the other children will know how to draw it.
2. Take turns with a friend calling out and drawing names of flat shapes.
3. Find flat shapes in the classroom. Draw and label them.
4. Draw complex shapes and try to name them.
5. Make a picture of the building you live in and the surrounding area with flat shapes.
6. Find out what polygons are and tell the other children.
7. Trace the flat shapes, cut them out and use them to make pictures of animals.
8. Collect pictures of flat shapes from magazines.

GRANNY

Mary Hentrich

Going into a school, even in its last quarter before summer break, I sense an electrifying air, a feeling I'm sure is in the blood of all teachers, or they wouldn't still be teaching.

Since I think of myself as a humanist, my first concern is not the curriculum, scores or achievements, but the interaction between the students themselves, the teachers and students, the teachers themselves, the administration and all, plus the miscellaneous and sundry folk who make up a working school.

It is about one of these folk I wish to share a happening.

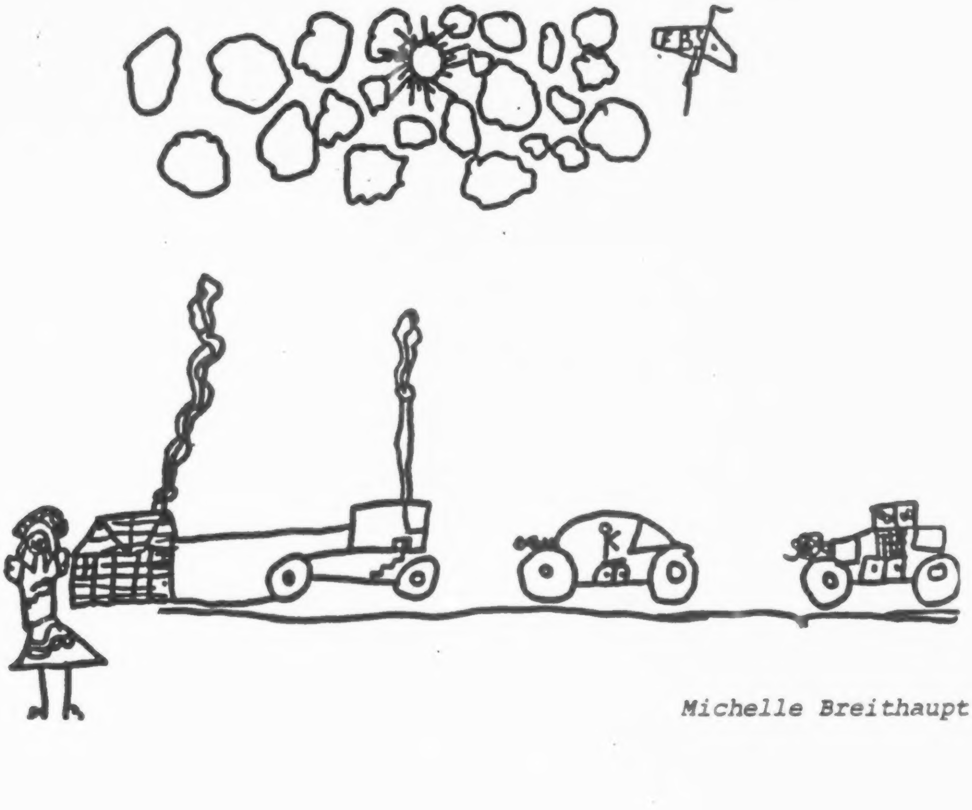
The day-lady janitor at my school was introduced to me on my first visit. She wished me well and I felt she would be a friend, which has proven true. I learned she has an aged mother in a nursing home, to whom she is very devoted.

As my weeks of internship passed, the janitor's mother, we learned, had become listless, detached, depressed, and refused to communicate. Clearly she was on a downhill course.

Using resources at hand, the lady janitor decided to take children from the third grade to visit "Granny". So, in groups of 3, these children gathered around Granny, who hadn't spoken a word for weeks. Being typical third graders, the children didn't mind at all that she didn't talk; they just babbled on, telling her how pretty she looked in her bed jacket, how much they liked the ribbons in her hair.... Before the visit was over, Granny's glassy stare had turned to intent listening, and she was smiling and nodding with interest and beginning to talk to the children, telling them how happy she was to see them and would they come again?

On subsequent visits, more children were invited to meet "Granny"; talk of bringing favorite pets to show her, collections of drawings and cards made during art were being prepared to present to her, a regular committee of "Cheery Folks" was formed throughout the school.

My point in relating this story, is that not all teaching and learning is done at a desk, with a textbook to follow. The bonding between those children and "Granny", plus the example of the janitor-lady's commitment and attachment to an aged parent, can never be measured by any achievement tests, but rather in life's worth -- a grand achievement in HUMAN-ness. A real school experience.



Michelle Breithaupt, Age 6

1991

DO YOU ALLOW CHILDREN TO THINK?

Linda D. McCrone

My task was to observe children think! I was puzzled at this task! How do children think? Better yet, why do children think? So often children aren't given the opportunity to think and develop their own awarenesses about their world. Instead they are asked to respond to a task with a memorized response. Why can't children be allowed to explore and search out for themselves the answers to questions? Why do children look at things and think about things in such a variety of different ways? Why must teachers often only accept one answer when in fact many situations allow for more than one correct response?

Thus my quest began. I set out to see some of children's thinking for myself. I'll share my "kid watching" experience with you!

The first thing I asked the children to do was to count. I asked them to count by tens beginning with 34. I interviewed second grade children -- one at a time.

Of the nine, only two children were able to count in the 'typical' counting by tens sequence. The rest of the responses were unique.

Four kids were able to count by tens to 104, but once they reached 104, they began calling out 105, 106, 107, 108. Counting by tens was easy for this group until the hundreds were reached, then the confusion began.

One child began the counting process at 34. The next number recited was 35, then 36, 37, 38, 39, 40. Once 40 was reached, counting by tens began -- 50, 60, 70, 80,...100. This child could count by tens only from a number divisible by 10.

The next child counted 34, 35, 45, 55, 65,...105. This individual knew how to count by tens starting with some numbers but not with others.

The last child interviewed began her counting at 34. She called out 35, 40, 45, 50,...100. She was counting by fives! Once she had reached 100, she switched from counting by fives to counting by ones -- 101, 102, 103,...110. This child switched gears twice.

Next I asked eight first graders to count 11 pennies. Of the eight children participating in the task, five resolved the counting experience by first grouping the pennies. One child arranged the pennies first in two groups of five which, in essense, totaled 10 then added the remainder of 1. Three of the five children grouped the pennies by threes. Once the pennies were arranged by threes, two of the children counted the pennies not by threes but instead by calling out "1, 2, 3, (pause) 4, 5, 6, (pause) 7, 8, 9,..." Thus the remainder was added in last allowing the sum to equal 11. Only one child who grouped the pennies by threes counted by threes, calling out "3, 6, 9." When she called out the last 2 pennies, she named them 10 and 11.

Oddly enough, only one of the five children who decided on grouping the pennies arranged the pennies in groups of twos. Her counting of the pennies was done by twos, adding the remainder of 1 last, totaling the 11 pennies.

Unique in their own ways, three of the children devised their own strategies and methods for counting the pennies. One child became so engrossed with the task that his procedure for counting involved that of the building of an architectural structure. He arranged the pennies in a pyramid.

1993

He commented that if he only had 1 less penny, he'd have a "perfect pyramid" instead of having to place 1 penny on top of the penny which appeared on top of the pyramid.

Another child devised a similar plan. She had recently heard of the "Leaning Tower of Pisa." Thus she set out to build that structure with the pennies. Placing one penny on top of each other, she counted each of the pennies as she carefully placed them one upon another until her monument was completed.

The last child, when asked to count the pennies, merely touched each one, sliding it to one side of the table while giving it its own name. Quickly and assuredly she called out, "1, 2, 3,..11," not hesitating once. After she'd finished, she looked up and said, "Cinch!"

For my final child watching adventure, I wanted to observe how children would respond to the statement, "What is one more than 342?" They were asked to write their answer to this question on paper. The results were astonishing. Of the eight second grade children polled, four children responded by writing the numeral 343.

One child responded 3421, while yet another wrote 1342.

One child interpreted the question to mean one more than the number at which my finger was pointing when I was explaining the task (at the time I was pointing at the numeral 4). Therefore, his answer was 5.

One boy added the string of digits, 3 + 4 + 2 = 9. Then he added 1 to his answer, 9 + 1 = 10, and came up with a figure of 10. Original, wouldn't you say!

Obviously, all these children don't think alike -- even though they're in the same grade at school. Keying in on a child's thinking strategies can help the teacher to better understand what's going on in a child's head -- how he is developing. Children need to be allowed to "think" without constantly receiving feedback of "correct" and "incorrect". They need to be encouraged to think and develop their own strategies and plans for solving particular problems. Unless kids are allowed to participate in these types of non-threatening experiences, they may not be able to refine and polish their thinking skills. If we, as educators, don't allow and even encourage children to grow and expand their thinking, are we treating them justly?

Think about this, please!

CHARACTERIZING CHILDREN'S THINKING ON THREE TASKS

Marjorie McEnany

The children interviewed during the three tasks were Josh and Jason who are going into third grade; Debbie and Jered who are going into fourth grade; and Tammy, Dawn, Ricky, and Laurie who are going into fifth grade.

The first task consisted of showing each child some popsicle sticks -- two bundles of ten and two single ones and asking them how many popsicle sticks there were in the group. Then three bundles of ten and three single ones were uncovered and each child was asked ho many popsicle sticks were there altogether. Without hesitation, all children gave the correct answers. Each one explained that they arrived at the total number by counting the tens first and adding th ones.

The second task consisted of showing the children a card like th 3 x 4 = ? and asking them to write the answer. Seven of the childre wrote the correct answer. One of the beginning third graders wrote eleven, but when asked if he needed to look at it again, wrote twelv

They were then asked to give a multiplication story problem usin the numbers 3 x 4 = 12. One beginning third grader said, "I can't remember anything about that," and one beginning fifth grader couldn complete the problem. The following are examples of story problems given by the others.

Beginning third grader, "If I didn't have any apples and somebod gave me 3 fours of apples, I would have 12 apples."

Beginning fourth grader, "Three pencils and 4 pencils. How many pencils?"

Beginning fourth grader, "Jason has 12 cards and Bill has 4 cards. How many more cards does Jason have?"

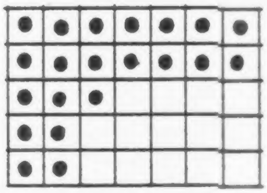
Beginning fifth grader, "Three rows of daisies and four rows of tulips. How many is that altogether?"

Beginning fifth grader, "Three pencils times 4 pencils equals 12 pencils."

Beginning fifth grader, "Three balls, four bikes, and twelve cars."

It's interesting to note that the beginning fifth grader who didn't give a problem worked on it for about ten minutes. He finally repeated, "Three groups of four," several times and finally said, "I can think of 3 apples and 12 apples, but I can't think of how to involve 4 in it."

The third task consisted of showing the children the following drawing and asking, "If you fill the box with circles by following the pattern, how many circles will you have?"



Two of the beginning third graders and one beginning fifth grader responded incorrectly on the first try. When asked if they wanted to count them again they answered correctly.

In explaining how they arrived at the answer, the beginning third graders and one beginning fourth grader said they counted the missing circles individually. One beginning fourth grader and one beginning fifth grader said they counted down by threes and added two more. Two beginning fifth graders said there needed to be five more in these groups and four more in this group and 5 + 5 + 4 = 14. One beginning fifth grader said she arrived at the answer by thinking 4 x 3 is 12 plus 2 is 14.

During these one to one interview sessions it was interesting to note how the children talked through the problems. Perhaps this indicates auditory learning is taking place. Two of the children responded in questioning tones. It was difficult not to assure them wholeheartedly that they had given the correct answers.

During the summer workshop there was some discussion about a child's feeling uneasy if he gives an incorrect answer and the "errors of his ways" are not pointed out. During the above interviews, once an answer was given each child seemed satisfied it was correct.

All the students interviewed thought more in concrete terms and were comfortable with information they had memorized such as groups of tens and ones, 3 x 4 = 12, and counting to find how many circles were needed to fill the box. Bumps in the road appeared when they were asked to think of a story problem.

Children at this age are capable of acquiring bits and pieces of knowledge but seem incapable of seeing relationships or synthesizing new concepts by taking old concepts and putting them together in new ways. Since one of our goals as teachers is to help students find relationships and synthesize knowledge, it seems as if this will have to be conveyed in structured situations and concrete terms. Again the problem arises of choosing the correct means of reaching our goal once that goal has been established.

Editor's Note: Please note that none of the children gave a correct answer to the question that was asked -- namely "...how many circles will you have?" They all addressed the same question however -- namely "...how many cicles must be added?"

Ginsburg & Opper, Piaget's Theory of Intellectual Development (2nd ed.) Englewood Cliffs, NJ: 1979. p. 153.

"...The pre-operational child deploys his attention in overly limited way. He focuses on one dimension of a situation, fails to make use of another, equally relevant dimension, and therefore cannot appreciate the relations between the two. (The notion of concentration is somewhat similar to Piaget's earlier concept of juxtaposition which is the tendency to think in terms of the parts of a situation and not to integrate them into a whole.)"

MISSION - POSSIBLE

Mary Hentrich

Hypothesis testing has been a large part of our work in the Spri '83 session of the Teachers' Center, Edwardsville group.

Since I've always been one who wanted to get to the "right" answer, using the shortest route possible, I have been struggling wi forming hypotheses, dealing with open-ended solutions, plus the boggling realization that math, as with life in general, does not always reach the same conclusions and by no means do we all use the same routes or tools along the way.

Trying to get children to begin to think, without fear or the inhibiting "wrong-answer syndrome", I have developed a game I call "Mission-Possible".

The skills involved are: development of language, hypothesis testing, observing similarities, information processing, question formulation.

This game is best for groups of 10 or more.

Procedure:

1. The leader is chosen who stands before group.
2. The leader thinks of two characteristics some of the children have, for example, white socks, brown eyes, or black hair and bl shoes.
3. The leader tells of "Mission" -- to find those people who have t two characteristics he has in mind.
4. Group members ask questions, first to find out WHO the leader is looking for and then WHAT the characteristics are.
5. The leader calls on volunteers, one at a time to ask questions.

6. The leader answers only "Yes" or "No".
7. The leader may not change characteristics.
8. Players discovered to be in the "Mission", becomes the leader and game begins again.

Note: With lower primary, only one characteristic could be chosen, with upper grades or to be more challenging, three or more characteristics may be used.

MY REALIZATION

Jane Vandersand

Fifteen years ago, for a short one and one-half years, I was a public school teacher. I didn't feel successful. As young teacher, I could see the children's eagerness and open minds, but I didn't know what to do with them. My prayer was, "Please, God, don't let me harm them." Recently, a combination of two events sparked my thoughts into realization of what I want for my classroom when I begin teaching again.

The first event happened simply. My son had a general knowledge science test at school. When I asked how he had done, his reply was, "It was easy. Pa taught me all those things on the farm." I thought appreciatively of the learning experiences Pa had given me and my children. I thought of spring plowing when he would always take the time to pick up objects he turned over with his plow. He would bring these rusty old tools and Indian artifacts to our kitchen table for us to manipulate and explore. This was learning without pressure, learning with pleasure, learning at its best.

Pa is my Dad. He doesn't know he is a teacher. He doesn't know the night walks he took with us, not to see but to listen, is superior education. He doesn't know that helping his grandsons count the rings of a fallen tree is education in its purest form. He imparts his knowledge with love to the people he loves the best way he knows - by doing.

Later, the same day of my son's science test, I had my first class at the Teachers' Center. Tom O'Brien and his colleagues created an atmosphere for learning that reminded me of those times around our kitchen table. With love for children as our guideline, we explored education. We explored with pleasure, without pressure.

While driving home after class, the two events of the day came together for me. As surely as a lost child recognizes his mother in a department store, I recognized the best atmosphere for learning. I knew it had to be an atmosphere of tolerance -- tolerance for answers, questions, opinions, and differences. I knew it had to be an atmosphere of exploration -- exploration of our own ideas, those of others, and the physical world around us. I knew it had to be an atmosphere of respect with equal shares given to all the divergent abilities. I knew it had to be an atmosphere of love with the child at the center.

IMAGERY -- THE FANTASTIC VOYAGE

Donna Thompson

The fantastic voyage of imagery -- where can it take the classroom today? Some teachers have already incorporated imagery in areas such as social studies, reading, and science. Why not implement imagery into elementary math?

What is imagery? Imagery is a mental picture produced in a person's mind as they listen to a guide describing objects, places, or events. In order to get the desired affect, the guide must be very careful in his use of language. A slight variation from the narration can cause an entirely different picture.

How can it be implemented into the elementary math curriculum? In using imagery to teach geometric shapes, addition, subtraction, multiplication, and division, the teacher gives the students something concrete that they can manipulate in their minds. The abstract meanings of geometric shapes, addition, subtraction, multiplication, and division now have meaning for the students.

An example of the use of imagery is as follows. A third grade class is learning their multiplication tables. All of the tables have been presented to the children. Upon being asked to recite the tables, the children are able to say each table in sequence. When the teacher gives the problems out of sequence, the children are confused and give wrong answers. The teacher then suspects that the children have only memorized the multiplication tables and the tables have no meaning for them.

The teacher then instructs the students to close their eyes, put their arms at their sides and relax. The journey has begun. She then tells the students that the next thing that they see is a large black space. She pauses for a few minutes. She continues by saying that four white circles are starting to form in the black space. (Sometimes children will give non-verbal clues as to whether they are getting the mental picture.) In each white circle are three chocolate chip cookies. Another pause. The next instruction to the class is, "It will take too long to add up all of the cookies in the square. What multiplication problem can you use to find the answer? Write your problem on a piece of paper." The journey has ended and the results were checked. The majority of students wrote down the multiplication problem of 4 x 3 = 12. Some students went as far as drawing what they had seen.

So imagery can be used to help children relate to a world that is at times too abstract. They can think about the problem in a much more concrete way.

COMPETITION

Debra A. Fagan

Students of today have many forms of competition to deal with. Some modes of competition are within the individual's ability to control, but other modes of competition are grave and consequential because the child has no degree of control over them at all.

Children have no control over the family budget, family size, or whether or not their parents are employed. Therefore, children have no control over the money that the family has or doesn't have. How then can children have any degree of control over what clothes they must wear? After all, if there is no money with which to purchase clothing, then the child must either accept the clothes given to him/her from friends or perhaps charity organizations, or wear hand-me-downs from older brothers or sisters. Something that sounds so trivial may in fact, be the reason why some children hate school or avoid going as much as possible.

It seems to me that the private schools are really on to something here. In most private schools the students are required to wear uniforms. This solves a great many problems. First, if a child's uniform was given to him/her or handed down, who would know? All uniforms look alike. If (s)he only has one uniform, or if (s)he owned a dozen, who knows? So in effect, the students would not have to compete in an area in which they have no control.

I don't mean to say that competition is always bad. But, competition should be with one's self. Children need to be evaluated according to the progress they have made during a given time period. When removed from the need to compete with other children, students often progress at a rate greater than one might have expected.

We should be sympathetic to the needs of children. Competition when related to one's self can be a positive thing. But it can be devastating when it is in relation to other children. The primary purpose of schools should be children's learning. Anything then, that interferes with this learning process, needs to be corrected.

PROBLEM SOLVING

Cheryl Miller

After hearing Shirley Casey discuss the research on children and multiplication she and Dr. O'Brien had done, I did a little research with an eleven year old boy. I found that the eleven year old could give correct responses to lots of multiplication problems. However, when I asked him how he might use 4 x 3 = 12 or could he develop a problem using 4 x 3, he said he could not. Even after changing the numbers and suggesting that he might use money, he still would not attempt to create a problem. He finally asked for some examples. Once he had heard my examples, he gave me examples exactly like mine but with the nouns changed. I then asked him if he could give me a problem using 64 - 8. His problem was: If there were 64 dogs and 8 fleas, how many dogs would the fleas get?

Dr. O'Brien recommended that I read "Children Learning Multiplication Part I," by Thomas C. O'Brien and Shirley A. Casey in School Science and Mathematics, March, 1983, and try "Solve It" activities by Thomas O'Brien. My findings with the eleven year old corresponded with Dr. O'Brien and Shirley Casey's findings. In addition the article mentioned that children used unrelated objects i their stories. I found the same. Instead of using nouns that he had dealt with, the boy used dogs and fleas. Why did he not use sports, money, or people?

Since the boy apparently could not develop problems on his own, I took Box E of Dr. O'Brien's "Solve It" activities. In this box were many cards labelled "answer, info, error." After doing approximately eight problems, I asked the boy to make up an "Error Please" story using two names. Most of the "Solve It" problems he had worked up till now had three names and he said he needed three names to develop a problem. He developed one about cookies and three children. I then asked him to do a problem with only two names. This one was about two children and bicycle speeds. Both problems could be worked (they had all the information needed for solving the problem). Things were improving already for this boy in creating story problems. The boy worked about eight more "Solve It" problems and then I asked him to create another problem. This time it was two people and their running speeds. Again it had a solution. I wondered if the boy felt confident enough to create a problem with not enough information to solve it. So, I asked him to create one. At first he said he could not but then he came up with one. I would like to share his problem with you.

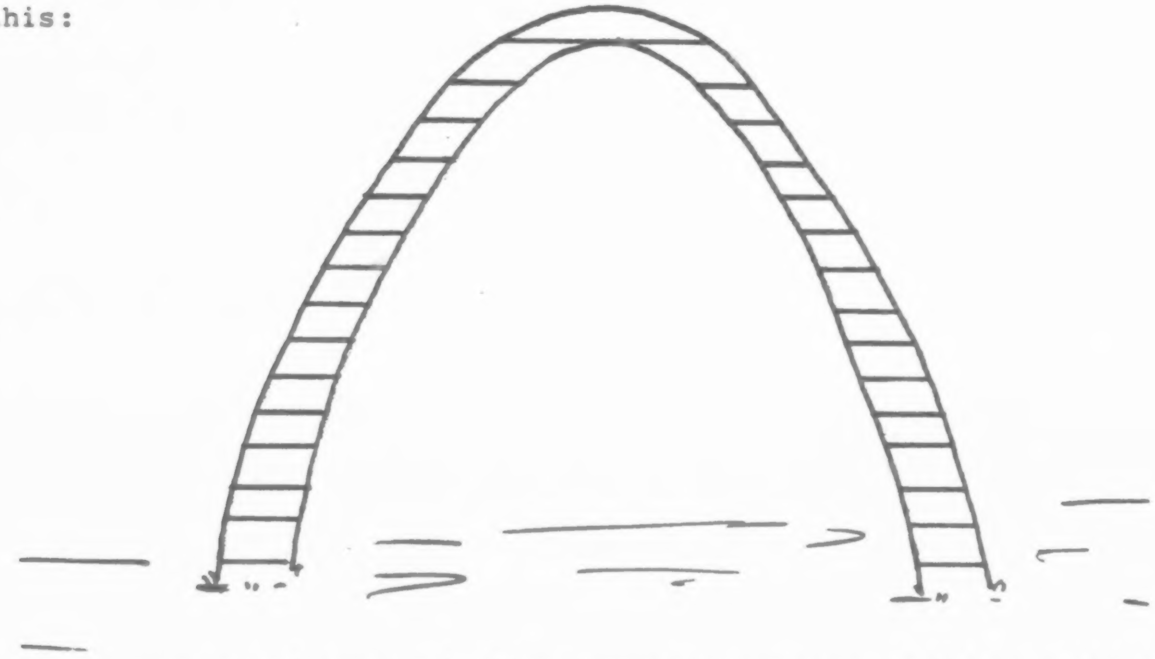
> "Scott is taller than Gregg by 2 cm. Tim on the other hand is taller than Scott. How much taller is Tim than Gregg?"

Not only was the boy able to create a problem that he would not attempt to do just a week before, but he was also relating the story to himself. The three names used were his and his friend's, and their heights are as the problem states.

Two things have developed for me from this research. One is how we (parents and educators) are cheating our children. Is it easier for us to solve their problems for them, so they do not have to struggle now? Or - Is is better to allow them (or offer them chances) to struggle now, solving their own problems, so solving problems in the future will be less of a struggle? Since we will not always be around to make their decisions or ease their struggles, I believe we should offer them opportunities now in making decisions and in real-experience problem solving.

The second development for me is to try and create a variety of ways in which children can solve problems and create new problems. I have thought of several methods. They could include the daily lunches. Example: We have 6 children buying lunches at $.90 each. Create a problem. Menus and other real life data could be brought in to have children create problems from and then they could ask the other children to solve their problems.

Games could be developed to add spice to the solving. One I am working on now is "Ride to the Top of the Arch." It would look like this:



Be sure to enlarge and allow enough spaces so children will have to work more than four problems. To make the game longer for older children, have them go up one side and down the other to complete a full trip.

Two players would play. A player rolls a die, but before he moves, he draws a problem card. If he answers the problem correctly, he moves the number on the die. Play continues until one player reaches finish. Include in the problem cards, problems with not enough information and cards that ask for the player to create a problem. This last card could also include the other player, in that, if he could solve the problem created by the first player correctly, he could move ahead two spaces. Problems could originate from "Solve It", or other books of good problems, or the teacher could create her own. As the children create problems, be sure to add these to the deck. As the cards grow in number the game would improve because it would be harder to remember all the answers. When developing questions, remember to relate problems to children's everyday events. An answer key could be helpful.

A CLOSE LOOK AT SOME EIGHT-YEAR-OLDS' THINKING

Nancy Pfeiffer

Introduction

My interviews center around 10 eight (or almost eight) year old girls. They will all be in the third grade this year. Four Belleville schools are represented by these girls. The girls names are Amy, Melanie, Kathy, Jackie, April, Robin, Karen, Stephanie, Heather and Denise.

In the beginning the girls were asked if they had ever used manipulatives with their math work. Only two had used counting sticks. The rest sheepishly said that they used fingers especially i their teacher was not looking.

The interviews were divided into three sections:

1. understanding the concept of 10 ones making 1 ten and the combination of ones and tens using A) beads and B) Lego blocks.
2. understanding the concept of telling a word problem.
3. understaning the concept of place value positions to add 3 numerals.

In each concept I looked at the group as a whole to see how they perceived each question. Then I looked at each girl separately to se where her strong or weak points were centered.

Concept 1

Part 1 Concept:

Understanding the concept of 10 ones making 1 ten and the combination of ones and tens using beads.

Part 1 Materials:

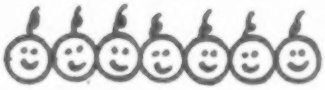
String of 100 wooden beads divided into groups of 10

4. Show combinations of ones and tens.

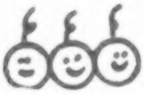
Found number using combinations.

Found number using only ones.

5. Show me 90.

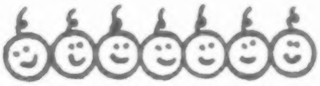


Found number using combinations.



Found number using only ones.

Interviewer covers 18 of the 90 beads and asks how many are still showing.



Found answer of 72 by using tens and ones.

Found answer of 72 by using only ones.

8 18 12 20 40

How many are covered?

Part II Concept:

Understanding the concept of 10 ones making 1 ten and the combination of ones and tens using Lego builing blocks.

Part II Materials:

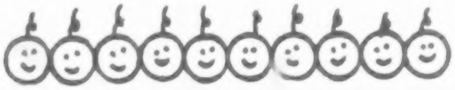
100 Lego building blocks of the same shape and size with 8 groups of tens and 20 ones.

Part II Questions:

1. We have talked about ones and tens. Would you make a group of tens. Show me other groups of tens.
2. Show me 62.
3. Show me 37. Show me 6 more. How many altogether?
4. Show me 54. Take away 7. How many left?

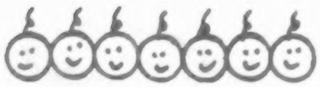
Part II Results:

1. Complete 1 group of tens.

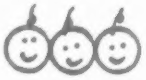


Able to make a group of tens.

Find other groups of the tens.

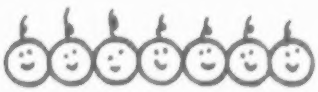


By size

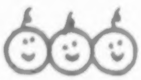


By counting

2. Show me 62.



Using combinations.



Using only ones.

3. Show me 37.

Using combinations.

Using only ones.

Show me 6 more. How many altogether?

By all ones.

By 3 tens and 13 ones.

By regrouping 13 ones to 1 ten and 3 ones.

4. Show me 54.

Using combinations.

Using only ones.

Take away 6. How many left?

Using combinations.

Using only ones.

Discussion:

Only one girl correctly guessed the number of beads on the string. One wouldn't even look at the string but kept looking into the sky. The other 8 girls all studied the string and then guessed between 20 and 300.

All but three of the girls realized by 40 that the beads were grouped by tens and changed their system of counting. The three girls continued counting by ones until 100. Even when asked if there was another way of counting, two said yes, "by tens" buy reverted back to using ones. They seemed more secure.

When asked how many on the whole string, nine girls determined 100 but one girl decided 90 and kept repeating 1, 2, ... 10, 10, 20, 30,... But, on the next section she went from 1, 10, 20,...correctly.

There were no surprises in finding combinations. Seven girls counted by tens and ones and three counted using all ones.

On the last question, all found 90 beads. Then I covered 18 of the beads with a paper and asked how many were showing and how many did I cover up.

The child with the correct response of 18 counted on her fingers from 72 to 90 not even considering the beads; four girls answered 8 because of the 2 still showing so 10 - 8; two answered 12 because of the 2 showing and 1 more color so 10 + 2; two answered 20 because 2 colors were missing so 10 + 10; one girl answered 40 just because she was a "good guesser".

I decided to see if one type of manipulative worked better than another. I took 100 Lego building blocks and had them build groups of tens. They seemed more at ease with the beads than with the Legos.

Not surprisingly the same three girls always used ones no matter what prompting I used. They also checked each group of tens by counting rather than comparing the size to the group of tens they had built.

Concept 2

Concept:

Understanding the concept of telling a word problem.

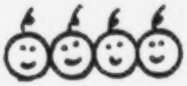
Materials:

None

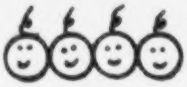
Questions:

Would you tell a story problem or word problem using 4 + 3.

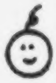
Results:



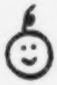
Understood Concept



No Answer



Didn't Complete with a Question



Multiplication Fact

Discussion:

Four girls had no idea what I was talking about when asked about a word problem. They said that they had never solved a problem like that before. These four girls all went to the same school which might be an indication of what the teacher did not stress the previous year.

One girl gave me a correct story but didn't finish it with a question.

One girl simply said 4 x 3 but she might have gotten that confused with a family of facts.

Four girls gave no indication that they found that problem boggling but quickly gave acceptable answers.

Concept 3

Concept:

Understanding the concept of place value positions to add 3 numerals.

Materials:

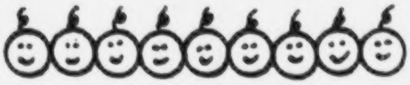
Paper with 3 numerals written on it, pencil.

Questions:

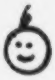
1. What is this number? 7
2. What is this number? 12
3. What is this number? 480
4. Add these numbers for me.

Results:

1. Reading 3 numbers.

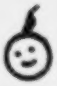


Could read all numbers properly.

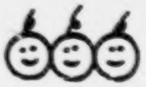


Made error reading numbers.

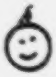
2. Added 3 numbers.



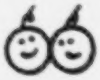
Figured in head



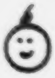
Added 2 numbers



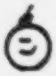
Wrong columns but correct answer



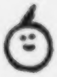
No concept



Wrong columns



Added just ones and tens



Correct concept

Discussion:

One girl added it in her head and could explain to me what she had done.

Two girls began by drawing lines but gave up on that notion.

Two of the girls could add 12 + 7 but did not know how to incorporate that into 480. One girl added 480 + 12 but lost the 7. One girl added the 7 + 12 + 80 but forgot the 400. Two used wrong column addition but one of them figured out the correct answer in her head.

All of the girls were somewhat baffled by this problem. There were a lot of questions -- a lot of soul searching.

After one of the girls added 7 + 12 = 19 she put

$$\begin{array}{r} 19 \\ +480 \\ \hline 571 \end{array}$$

(1 + 4 = 5, 9 + 8 = 17, put down the 7 carry the 1, 1 + 0 = 1)

So I asked her how this problem used the tens and ones we had spoken about. She turned her paper over and said, "Oh yea, ones with ones, and tens with tens."

PROBLEM SOLVING AND MATHEMATICS

Mary Steffen

Introduction

In the recent past there was need for a large number of people trained in accurate calculation. Little knowledge was needed beyond the accurate application of preconceived solutions or formuli. Today, and more so in the future, the demands are quite different. Calculators and computers have taken the drudergy out of calculation and placed a premuim on an individual's ability to select a process, to invent a solution, and to select or devise a strategy. Calculations become the territory of calculators and computers.

Today's schools, caught up in the texting syndrome, place a premium upon students' becoming rapid and accurate calculators. Students are expected to master algorithms with little if any experience in their usefulness in the real world. The result is that test scores show gains in memorized skills and the schools look good competitively, but students are poorly prepared to be the thinkers called for by the future. Students' experience in learning higher level thinking skills should not be sacrificed for the short term goal of higher standardized test scores on memorized algorithms.

Allowing ample time for students to explore problems, to invent solutions and to internalize processes would place the emphasis where it belongs; upon higher level thinking skills. Calculation skills -- estimation, in particular -- which students acquire during problem solving could be developed as part of a useful thinking process, rather than as an isolated, linear skill.

The classroom teacher who genuinely wishes to offer students experience with the higher level thinking skills of problem solving will wish to consider three topics: Choosing Problems, the Classroom Atmosphere, and Questioning and its Relationship to the Problem Solving Process.

Choosing Problems

A number of considerations are inherent in choosing worthwhile problems.

1. Examining one's past problem solving experience in search of solutions and approaches that might be useful in solving a current problem is a valuable technique for all problem solvers. Care, then, should be taken to select problems which provide a variety of approaches and methods so that students can gain a repertoire from which to make future choices.
2. Another valuable technique involves reflecting upon the process one has used in solving a problem. During this reflecting time, patterns are searched out which have been used in the past. From these patterns, generalizations can be made. Focusing on these generalizations will encourage students to internalize the processes they have found successful. Choosing problems which offer analogous solutions will facilitate the students' chances to internalize the problem solving processes. That is to say, problems involving patterns are often worthwhile for children.
3. Searching for processes or strategies which have worked in the past is not the only way to solve problems. Care should be taken to offer problems which encourage original solutions. Problems having multiple solutions or multiple methods of solution encourage the confidence students need to try out many (possibly

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unproductive) solutions in their search for an original way to reach a solution and in the defense of its validity.

4. A caution in regard to kits and booklets on the topic "problem solving." Many are available, but often they deal with only one kind of problem, one correct solution, solved in only one way, with one step from problem to solution. Teachers can make use of these single purpose problems as trivial springboards to more independent thinking rather than as ends in themselves. Offer these as beginning experiences and focus upon the process used in solution finding. Later students can make use of them as beginning approaches to long, richer problems.

Recommended Problem Solving Materials

1. *Solve It!* Thomas C. O'Brien, Educational Teaching Aids, Chicago, 1977.
2. *Basic Thinking Skills* - series, *Inductive Thinking Skills* - series, *Mind Benders,* and *Critical Thinking* - Book I and II, Midwest Publications, P. O. Box 448, Pacific Grove, CA 93957.
3. *Think Lab*, SRA.
4. *Wollygoggles and Other Creatures: Problems for Developing Thinking Skills*, Thomas C. O'Brien, Cuisenaire Co., 1980.
5. *Puzzle Tables: Number Problems with Computational Skills*, Thomas C. O'Brien, Cuisenaire Co., 1980.
6. *Pegboard Games*, D. G. Tahta, Association of Teachers of Mathematics, Kings Chambers, Queen St., Derby, England.
7. *Sticks: A Collection of Ideas for Teachers*, Mathematical Investigation in the Classroom and Points of Departure - I and II, Association of Teachers of Mathematics, Kings Chambers, Queen St.,

Derby, England.

8. A Cloudburst of Math Lab Experiments, vol. 1 and 2, Buckeye, Ewbank, Ginther, Midwest Publications, 1971.
9. Mathematical Activities From Poland II: Logic Blocks, Jerzy Cwirko-Godycki, Teachers' Center Project, Southern Illinois University at Edwardsville, 1980.
10. The Double Helix: Teaching the Writing Process, Barret, Mulliken Tathert, Steffen, Hawkins, Ferguson Florissant School District, 655 January Ave., Ferguson, MO 63135, 1981.
11. First I Think: When I Write I Think, Leif Fern, Kabyn Books, P. O. Box 19663, Navajo Station, San Diego, C A 92119, 1981.
12. The Pattern Factory, Roper and Harvey, Creative Publications.
13. Cuisenaire Roddles, Dickens and Sellon, Cuisenaire.
14. Dot Paper Geometry, Lund, Cuisenaire.
15. Calculator Explorations and Problems, Miller, Cuisenaire.
16. The Productive Thinking Program #3, Covington, Crutchfield, Davie and Olton Jr., Merrill Publishing Company.
17. Visual Logic: Conjunction, Cwirko-Godycki and Karczmarczyk, Midwest Publications.

Additional Materials Suggested for Teachers

1. A Total Creativity Program For Individualizing and Humanizing the Learning Process, Frank E. Williams, Educational Technology Publications, Englewood Cliffs, New Jersey 07632, 1972.
2. How To Solve It, G. Polya, Princeton University Press, Princeton, New Jersey, 1957, 1973.
3. Thinking Mathematically, John Mason, Addison-Wesley, London, 1982
4. Geometric Images, Dick Tahta, Association of Teachers of

Mathematics, Kings Chambers, Queen St., Derby, England.

The Classroom Atmosphere

Sidney Parnes' description of the teacher as facilitator accurately depicts the classroom atmosphere necessary for students to develop problem solving skills.

> "The effective facilitator needs first of all to believe in human dignity of people - in their capability as creative beings. He or she needs to be open to ideas and viewpoints, prone to question rather than to tell, ..."

Enthusiasm is very helpful in a facilitator, but there can be a kind of self-evident sincerity as well as the bubbly type of enthusiasm. Some of the other qualities that come to mind when I think of effective facilitation are the following: sense of humor, acceptance of all kinds of decisions, ability to live happily in ambiguity - not just tolerate it; invites amibiguity perhaps - yet maintain the balance necessary for bring about an ultimate greater order from the disorder in the ambiguity (via the creative process); always looks for something good or positive in a circumstance, a person, a thing; tactful; can remain on the sidelines - doesn't need the spotlight; is kind and concerned; optimistic; laughs or smiles a lot; doesn't take self too seriously; interested in others; is a hard worker - self motivated; sincere; dedicated; confident that the creative process will carry one through; willing to take calculated risks where one's own efforts in the risk may make the difference; spontaneous; flexible; accepting; can get a group to adhere; had group-building ability; is aware of nonverbal clues, feelings, etc., respects potential of individuals and the group as a whole; makes fun and play out of the process at many points - tolerates some foolishness - but always toward a serious objective; plays hunches; i conscious of time constraints, but flexible with them.

As to knowledge involved in the content-or problem-area being considered, the more the better. Although a good facilitator can do without complete expertise, one can apply the creative process to the problem of seeking out information and helping classroom students or teachers or members of a problem-solving group to do so.

Facilitating the creative process involves primarily removing the blocks to creative functioning, and accelerating the process where possible. Basically we might say that the psychological blocks hindering creative behavior are both internal and external. Starting from the outside, it behooves the leader to establish a kind of climate which provides for what Carl Rogers calls psychological freedom and psychological safety. The participants must feel at ease -- free to explore, to play, to experiment, to fail in the early stages of each step of the process, with full understanding that the deferring of judgement during this period of spontaneity and experimentation will be followed by significant analysis, development, evaluation, and synthesis as required in the total process. They mus not only feel psychologically safe and free, but sure as well that their efforts will be worth some significant results and will be followed through toward some valid conclusion and action.

As to the internal blocks, these refer to the "internal governors" that individuals have, often unknowingly, that prevent them from full functioning. Basically they revolve around two key aspects: habit and anxiety. Habit causes individuals to jump at the first response that comes to mind regarding a problem -- to make the first associations among the data that we have in our brains, we need to inhibit the impulse to act on one's first idea, as psychologist L. L. Thurston stated long ago.

However, if one does avoid habit, one frequently finds oneself dealing with strange or novel thoughts and ideas to the question of anxiety about these thoughts. Once we are not on the tried and true path-knowing where it will take us-we are frequently concerned or afraid, and will therefore forego any further consideration of the less obvious ideas, staying with the tried and true for safety's sake.

One of the best means that we know to deal with these blocks, both internal and external, is the deferred-judgement principle. Deferred judgement implies listing all of one's ideas as fast as they come to mind, with no regard to quality at the moment. One strives for as fast a flow of ideas as possible-combining, rearranging, associating, and triggering of earlier thoughts as fast as possible, avoiding all judgement for the time being - knowing full well that once a quantity of ideas has been produced, these chosen for further development and implementation.

This process is easy to understand intellectually, but very difficult to follow behaviorally, because of a lifetime of sets which we have established in our minds with respect to judgement, accuracy, etc. However, research has established quite consistently that the deferred-judgement principle, whether used by an individual or by groups, can be a significant accelerator of idea production, as well as a stimulus to the production ultimately of valuable solutions that work effectively for our problems and challenges.

Questioning and its Relationship to Problem Solving

Solving a problem seems to come in no particular order, but rather through exploration of a rather diverse network of possible connections between data known and anticipated solution. When several students are asked to talk about the route each has taken in pursuit of a solution, one finds overlapping journeys, crossed trails, retracked pathways. Eventually the problem solvers may wind up with solutions which are similar, analogous or identical. Each has traveled at speeds and pathways determined individually. Prescribing a specific set of steps for such a journey is absurd.

George Polya, a patron saint of Problem Solvers, suggests a model for problem solving which provides both traveler and teacher with a way of viewing problem solving without ritualizing the diverse network of connections one makes during problem solving. While his model is well known to students of mathematics, few elementary teachers make use of his gift to the teaching of problem solving. Likewise, few authors of elementary curricula concerning problem solving do more than offer ritualized steps which reduce problem solving to groups of memorized solutions.

Polya places great trust in the use of questions, by both student and teacher, during the solving of problems. What follows is an attempt to make Polya's wisdom a bit more accessible to the classroom teacher.

Professor Polya groups his questions into what he terms "four phases of work." First, we have to *understand* the problem; we have to see clearly what is required. Second, we have to see how the various items are connected, how the unknown is linked to the data. That is, we need to make a *plan*. Third, we *carry out* our *plan*. Fourth, we *look back* at the completed solution; we review and discuss it.

An individual's journey through Polya's phases of work is not a linear pathway, but rather a shifting of points of view about the problem. The series of questions considered while solving one problem may occur in quite a different order for the next problem. What is constant is that the questions offered in each phase are useful points of view in considering problems. Often a number of questions must be tried before a useful one is found.

Polya suggests two purposes for his questions; to help the student solve his own problem, and to develop the student's ability to make use of similar questions in solving future problems himself. Formulation of questions from the common sense methods one uses in solving everyday problems and making them general enough to be used over and over will satisfy Polya's criteria for a good question. The student who hears the teacher use generalized commom sense questions over and over can internalize such questions as helpful in problem solving, and will eventually use them independently.

Let us now proceed to discuss each of Polya's four phases in terms of the kind of questions which are helpful in each.

First: You Have To Understand the Problem

Questions: What do you know? Can you say the problem in your own words? What do you want to know? Is there something you need to know that the problem doesn't give you? Would a picture help? A chart? A list? What rules do you have to follow? What kind of answer do you expect?

Young students often need time to get acquainted with the problem. Students who are encouraged to explore, to play with the data, will be free of the common assumption that a "right answer" is the only desirable work. A few false starts or wrong answers are usually more useful in clarifying the students' ideas about the problem than one quick right answer.

Sharing what students learned during the get acquainted activities clarifies everyone's understanding. Such students know that good "ideas" come from the students' minds.

Second: Devising a Plan

Questions: Is this problem like any you have already solved? Can this problem be solved the same way? Is the way you solved this problem the same? Is the answer the same kind of answer? Can you say this problem differently? Here is a problem like yours, can you use it?

These questions are of very general nature. Why such general broad questions?

Children typically have a great deal of information stored away. Schools often ask students to respond to questions with pieces of isolated information. What is the sum of 10 and 19? Who discovered America? What is the capital of Wyoming? But the nature of problem solving demands another level of student response, finding (or building) and then using connections between ideas. The teacher's role here (in finding a plan) is to remind the student of some known question/answer sequence and then focus his or her attention upon the way he or she traveled between the question and the answer. In doing so the student learns that problem solving is a process of making connections rather than memorizing solutions. If the teacher asks these questions often enough, the student will begin to internalize the questions as well as the methods of solution each suggests. Thes higher level thinking skills will then be his to take along as he journeys into his future of solving problems.

The teacher can begin with general questions such as those above and proceed gradually toward more specific questions such as these:

Questions: Can you imagine an easier problem just like this one? Here is an easier problem just like this one. Would solving it help? (Selection of an easier problem might include the following: more general, more special, or analogous problems.) Related questions might include: Can you find only the largest? the smallest? all of them? one part? the order?

Questions: What can be found with the information? Will that answer help solve the problem? What are the rules? Have you used all of them? Can you use more now? Can you work backwards? Start at the solution and work toward the question?

As students search for a plan, care should be taken to assure that the students actually find the plan for themselves. Teachers are notorious helpers of children, so much so that the natural frustration shown by student problem solvers becomes painful for the caring teacher. Often it is easier emotionally for the teacher to show the student a workable solution. A question teachers might ask of themselves in such situations: Is it more helpful for the student to succeed after frustration or to depend upon always being shown? One solution is for teachers to show by their questions that they have confidence in each student's ability to find a solution without being shown. Such students will grow in both problem solving skills and in their confidence in their own ability to devise appropriate methods of solution as they are needed.

Finding a plan is the real achievement in problem solving, says

Polya. While the pathway from problem to plan for solution may be long and torturous and gradual, other pathways may appear as a flash of insight, a bright idea. Using the questions here will give students every possible chance of having such a bright idea.

Questions that arise spontaneously out of a problem solving situation are likely to be valuable ones, if a few points about teachers' questioning are practiced. Questions should be unobtrusive They should flow naturally from the student's approach. Listen to th students talk about the problem and learn his or her point of view before formulating a question. Make the question one that might have occurred to the student himself. Take into account the student's ability. Choose problems which will develop relationships, not just cover subject matter. Choose questions general enough to be applicable to many problems. These develop what Polya calls "good mental habits."

There is, for most people, an intuitive aspect of problem solving Suggesting to students a pause in their thinking followed by a return to the problem can be quite useful.

Third: Carrying Out the Plan

Questions: How do you know your solution is correct? Can you show why? (Proof)

Carrying out the necessary steps to a final and complete solution is often routine work. Students will often rush through and finish before checking to see that each step is correct and complete. Returning to phase two and even phase one can be encouraged by questions from the teacher.

Young students should not usually be forced to search for formal

Proof. An intuitive proof in the form of explaining to others what was done and why it is correct is far more useful. (For Polya, proof is "a convincing argument.") Students who know they must talk about their solutions will take care to avoid mistakes and will want to search out all solutions. Formal proof -- the sort of stuff we all did in high school -- is best left to high school students (or beyond). It is not an elementary school issue.

More specific questions include: How do I know that is true? Can the same solution be found another way? Can you say more about that? How do you know that? Why do these go together? Why were these left out? What would happen if . . .?

Fourth: Looking Back

Questions: Can you get the same answer another way? Can you use this way (method) to solve another problem? Can you say what sort of problem? Can this solution be used to help solve another problem?

Because young students primarily involve themselves with intuitive proofs, much of the thinking and discussion from stage three and four are overlapping. Emphasis is placed upon seeing the usefulness of methods used and results obtained in solving future problems. Young students are not usually able to think about their own thinking, but they are able to recognize and use methods which they have used successfully in solving past problems.

A few more specific questions for phase four: What if parts of the original problem were changed? Is this solution like any other you know about? Can you imagine another time this method might be useful?

The teacher who takes a respectful attitude toward the thinking of young students, uses questions thoughtfully and nonintrusively during the four phases of problem solving, and selects problems for condiseration which encourage students to find patterns and internalize processes will find that students become problem solving people not only mathematically but in their lives generally. Such students will be adequately prepared to meet the demands of rapid changes in the future.

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Parnes, Sidney. Creative Leadership.

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Polya, George. Mathematical Discovery. New York: John Wiley & Sons, Inc., 1962, 1981.

LINES AND SQUARES

Michael Garland and Julie Wilcox

Our class was presented with an activity that involved finding out the smallest number of lines needed to make exactly 100 squares. We decided to simplify the original problem by changing the problem into a new one. Our new problem is finding the smallest number of lines needed to make exactly 10 squares. Each person basically had an idea on how to reach a consistent pattern. We worked with grid paper and pen to draw different arrangements of squares. We then decided to combine our thoughts and drawings. Here are the six arrangements of squares we used.

The first method we found was the vertical arrangement of squares.

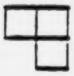
Example: 5 squares, 8 lines

Our second method was the horizontal arrangement of squares.

Example: 5 squares, 8 lines

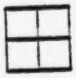
The third idea we discovered was the open arrangement of squares.

Example: 3 squares, 6 lines



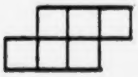
At first we did not realize that the squares could overlap each other to make more squares. Our fourth discovery was the overlapping arrangement of squares.

Example: 5 squares, 6 lines



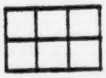
The fifth method we found was a combination of open arrangements of squares and the overlapping arrangement of squares.

Example: 7 squares, 8 lines



The last method we found was using the double overlapping of squares.

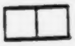
Example: 8 squares, 7 lines

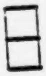


The following is how we proceeded to find the smallest number of lines needed to make exactly ten squares.

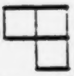
We started with one square, 4 lines, finding that there could be only four possible lines and only one possible arrangement of the squares.

We continued with two squares, 5 lines, finding that there were only two possible arrangements with each containing 5 lines.

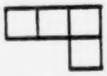


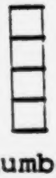


We worked with 3 squares, 6 lines, also finding only three possible arrangements, with each arrangement having 6 lines.



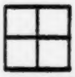
Then we used 4 squares, 7 lines, and again found three possible arrangements with each one containing 7 lines.



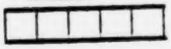


We worked with 5 squares, finding a new development in the problem. There appeared two possible answers for the smallest number of lines found in 5 squares. There were four possible arrangements for 5 squares.

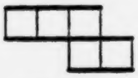
5 squares, 6 lines



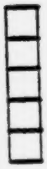
5 squares, 8 lines



5 squares, 8 lines

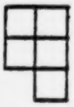


5 squares, 8 lines

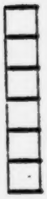


With 6 squares we used four possible arrangements of squares.

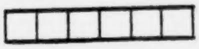
6 squares, 7 lines



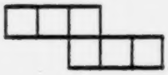
6 squares, 9 lines



6 squares, 9 lines

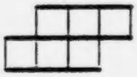


6 squares, 9 lines

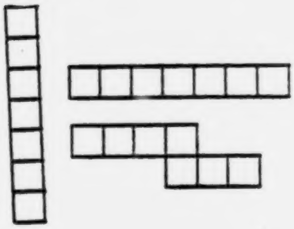


With 7 squares we also used four possible means of arranging the squares.

7 squares, 8 lines

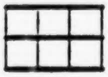


7 squares, 10 lines

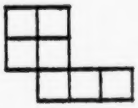


In our next step, two new variables were added. We now found that there appears three possible answers for the smallest number of lines found in 8 squares. We used five possible arrangements for 8 squares. There occurred a double overlapping arrangement.

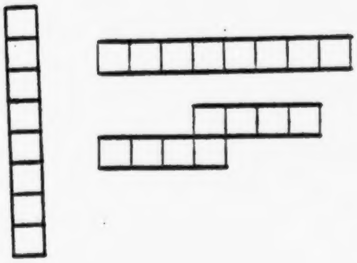
8 squares, 7 lines



8 squares, 9 lines

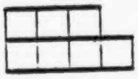


8 squares, 11 lines.

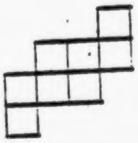


Once again we found there could be three possible answers for the smallest number of lines in 9 squares and there occurred another double overlapping arrangement. We used five possible arrangements for 9 squares.

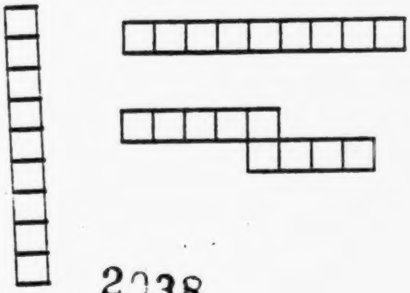
9 squares, 8 lines



9 squares, 10 lines

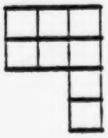


9 squares, 12 lines

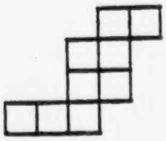


In the last step we found that once again there could be three possible answers for the smallest number of lines in 10 squares. We used five possible arrangements for 10 squares.

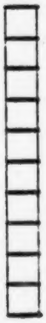
10 squares, 9 lines

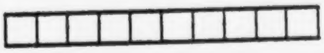


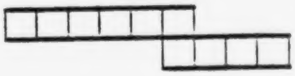
10 squares, 11 lines



10 squares, 13 lines







After reviewing the six arrangements for finding the smallest number of lines needed to make 10 squares, we compiled the following results.

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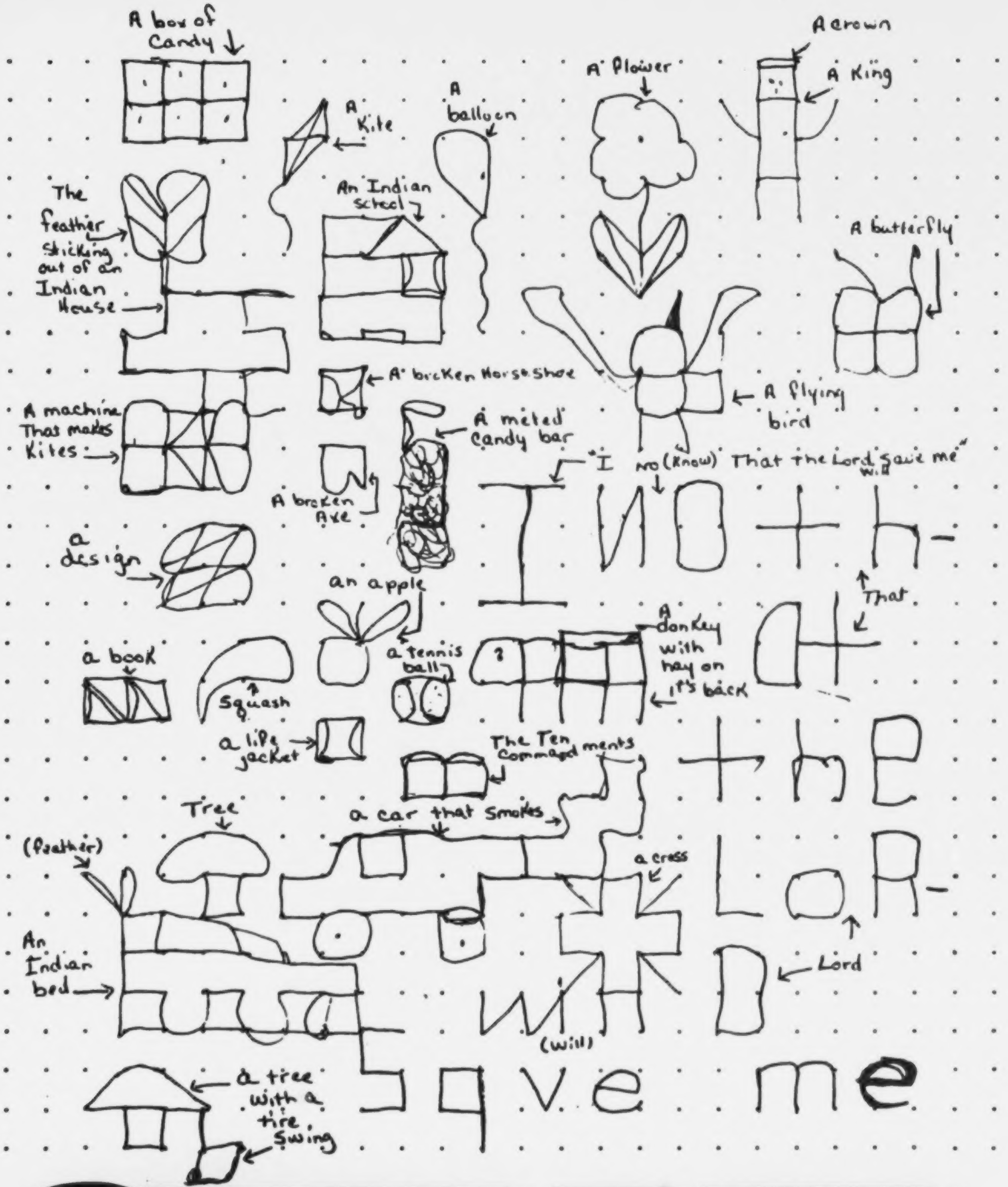
A box of Candy
A Kite
A balloon
A flower
A crown
A King
The feather sticking out of an Indian House
An Indian school
A butterfly
A broken Horse shoe
A machine That makes Kites
A meted candy bar
A flying bird
"I no (Know) That the Lord will gave me"
A broken Axe
I NO th-
a design
an apple
That
at
A donkey with hay on it's back
a book
Squash
a tennis ball
a life jacket
The Ten Commaned ments
the
Tree
a car that smokes
(feather)
a cross
LoR-
An Indian bed
Lord
wi D
(will)
qve me
a tree with a tire swing

SEEDBED

SEEDBED

NUMBER 20

November 1984

Teachers' Center Project

SIUE

**Southern Illinois University
at Edwardsville**

2043

INTRODUCTION

This is the first time in a long time that I've handled a SEEDBED all by myself. Yikes, proofing and editing and corraling art and arranging for typing and printing! Shirley Casey, I miss you.

But it's a labor of love. To make available teachers' ideas on behalf of children's growth is a wondrous opportunity.

Herewith we present two SEEDBEDs.

SEEDBED 20 grows out of the work of Teachers' Center participants in the spring of 1984 (with an occasional piece from earlier days 'cos previous SEEDBEDs were too crowded).

There are several things worth noting in SEEDBED 20. First of all, the cover art was originated by Teachers' Center participant Ginny Breithaupt's twin six year old daughters. Ginny gave her kids some dotty paper and asked them to make of it what they could. Pretty imaginative, yes? What can you learn about Angela and Michele from their artwork?

The CUTTINGS in SEEDBED 20 — as CUTTTINGS sections in previous issues -- are excerpts from the diaries which Teachers' Center participants keep each week. Rich stuff, both in their content and quest. Engage these diaries and catch the flow of teachers' growth on behalf of children's thinking?

What are the drawings at the foot of the various articles in SEEDBED 20? They're the results of teachers' interviews of children on the classic Piagetian "tilty cup" experiment. What happened was that teachers presented transparent cups half filled with colored fluid to children at various ages. The cups were tilted as shown, in full view of children, and the children were asked to draw — on pre-prepared ditto sheets -- what they saw. Rather unbelievable, aren't they? There are a lot of developmental details one could go into, but the most important aspect of the research is that many of the children's pictures show situations which could not exist in earthly reality, which children could never have seen in real life. The point is that the mind is NOT a camera. Children — as we all do — interpret reality in terms of their existing cognitive networks. (Ginny Breithaupt's article, late in SEEDBED 20, gives a fuller explanation of the research.) What do you make of the pictures? Why not try some similar research yourself? Should we continue, as teachers, to act as though children's minds were cameras?

SEEDBED 21 is the result of our Teachers' Center summer 1984 session concerned with computers and the development of children's thinking. Again, you see teachers growing and sharing their knowledge on behalf of children's thinking. Again, you will certainly see lots of stuff you've not seen elsewhere.

The cover art is a picture of a computer drawn by five-year-old Danny at Teachers' Center participant Peggy Funkhouser's early childhood school in East Alton.

The artwork at the foot of various articles was drawn by teachers and local students with the Koala Pad, an amazingly versatile and captivating graphics microcomputer tool.

And, as an extra bonus, SEEDBED 21 draws on the work of three Teachers' Center friends, Hassler Whitney (Institute for Advanced Study) and Mieko Kamii (Wheelock College), and Stephen Rowland (Leicestershire Education Authority).

A brief word about Stephen Rowland. I met him at the annual meeting of the Association of Teachers of Mathematics in London in April 1984 and thought his paper, reprinted with permission herein) one of the most thoughtful pieces I'd seen in a long time. "Can I reprint it in SEEDBED," I asked. "I'd be delighted," he said, "but Tony Kallet is already planning to print the piece in Mountain View Center's OUTLOOK. Better ring Tony." Upon return, I phoned Tony Kallet, who said, "Of course, print the article. The more widely good stuff travels the better!"

Subsequently I learned about Stephen Rowland's book, "The Enquiring Classroom" (Falmer Press, distributed in the US by Taylor and Francis, Philadelphia). It's not only superb in itself but it's part of an eight volume Falmer Press series on education which demands to become better known by American educators.

SEEDBED 21 also makes available news of the widely praised new research "The Second Self" by MIT sociologist Sherry Turkle. Read the review and rush to your bookstore!

Warmest thanks to Jean Wigger, who handled much of the production of these two SEEDBEDs and who went way beyond the call of duty, as usual, in her labors, and to Patricia Atkinson and Diane Jacober, who typed much of the first draft of these articles.

Engage and enjoy what's here. Knowledge is not a spectator sport.

University City
22 October 84

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Cognitive Materials and the State Inspector

Peggy Funkhouser

It is time for our annual licensing inspection at the early childhood center, and I am doggedly going over the lists of requirements one last time before the "state inspector" comes. The list of required materials calls for a cognitive game or material for every two children enrolled. If you look closely, you will see the beginning of a frown, and a wrinkle at my brow. It's not that I object to this requirement, you understand. It's just that I am trying to picture an environment so stark and barren that it would have only a countable number of cognitive materials in it.

I must describe our Licensing Coordinator for you. She is a very polite young lady, a veritable storehouse of information. She can quote rules by page and section, and she has a rule for every eventuality. She is a real whiz with files and forms. She can find an empty blank at 20 paces. And thorough! She spends hours pouring over those papers.

A rather sadistic grin spreads over my face as I picture a very polite confrontation with THE INSPECTOR. "Well," she will state without quite meeting my eye, "I have just counted your blocks and you do indeed have 144 large, and 200 small building blocks as required (section 407, page 51, appendix C). Now let's move on to cognitive materials (section 407, page 52, appendix C).

She will even show me the appropriate page in the rule book and, sure enough there it is along with an explanation that cognitive means numbers, letters, shapes, size, and color.

She will get out a pencil and paper and begin to figure. "Considering your total enrollment of 63 three and four year old children, you must have one for every two children, let's see....63 ÷ 2, that's 31 and 1/2 cognitive materials. May we start with a complete description in triplicate, manufacturer, supplier, designer, and price?"

"Well," I will tell her with a serious face, "Let's start with fingers." "Fingers," she will say with a puzzled look, "Could you spell that for me? Is it a new game?" Then I'll show her the empty cup, a walnut, the sand box, a cardboard box, the wastebasket, the wash basin, the sun, dirty faces, rain, the garbage man, a worm, a smile and a frown, a runny nose, a new dress, an old doll, a temper tantrum, a hug, a pat, a race, a piece of string, a mud puddle, a bottle cap, a broken swing, an old magazine, a wilted flower, a seashell, a bucket of water, Amanda's new baby sister, a clothespin, and a half eaten cookie.

Only then will I take pity on her look of panic. What is the matter?" I will ask solicitously. "Didn't I count right? Let's see, one, two, three, four, five....yes, thirty one, and the cookie makes one half." As she runs screaming from the building writing in her ubiquitous little book, I will go back to my teaching!

"Oh well," I think as I line up thirty one neat little boxes, "It was a nice dream!" I put on my nicest smile, and turn to greet our INSPECTOR.

CUTTINGS

Karen Riess

As recommended in class, I had seventh and eighth grade students of varying "ability levels" skip count. I had them first start at 0 and count by threes. All students, with the exception of one, could do this easily until they got to around 40. The upper ability students could continue from there effortlessly, but some of the others paused before continuing. They told me that after they got to 3 x 12, they didn't know any more multiplication tables, had to add in their head, and that's why they had to pause. The girl who had difficulty counting by threes at all gave me this response: She started at 3, and then said "4". She then said "4,5,6" emphasizing the 6 as her answer. She then said "6,7,8" emphasizing the 8 as her answer. Basically, she was reciting the even numbers. When I questioned her as to why she started with 4, she said it was just a better number to start with. When I asked her how she got 6 as her next number, she held up her fingers and said, "4,5,6. See, that's three numbers."

I next asked students to skip count by 6's. One of the lower ability students could get to 6,12,18, and then finished with, "Is this for a grade? If it's not, then I'm not going to do any more." After encouraging him to go on anyway, I found that he had to count on his fingers to go any farther. Another lower ability student got to 60 easily, but then continued with 66,70,76,80. The girl who could not count by threes (at least in the manner I had expected) got so flustered by the 6's that I told her she could quit. One average ability student put marks on his paper and could easily get numbers into the hundred's. Upper ability students had little difficulty, although they did seem to pause to add when numbers got over 100.

Now I asked students to skip count by 6 starting at 87. The student who wanted to know if he was doing this for a grade said that he already did enough work for no credit and wasn't going to do this. A simple "please" got him to try, and he used pencil and paper to get the answers. He said he couldn't do it mentally because "all of the numbers just kind of lay around up there and they don't make any sense." The girl who counted 66,70,76,80 now counted 87,93,100,106,110,116. The boy who used marks on his paper could again find the next number quickly and accurately. When I asked two upper ability students, they could count rather rapidly 87,93,99,105 (a little longer hesitation there) and easily on to 111,117,123,etc. When I asked them why it seemed easier after they got over 100, they said that it was just like working with smaller numbers, but they just had to put a one in front of them. One boy (whom I consider to be the top of the eighth grade) raised his hand and asked if this were leading up to more algebraic expressions since he thought we were just solving the expression 6x + 3. Shortly after, he came to my desk with a list of values substituting increments of .5 into the expression and informed me this was just like counting by 3's starting at 6. I asked him what happened if x was replaced by 0 and he happily informed me "then we get to start at 3".

I became interested in the boy who had put marks on his paper to count and asked him to count by 7's starting at 87. He tried doing this in the same manner, but looked up and said that it just wouldn't work. "Seven just doesn't have the same rhythm as 6. I just can't get that extra beat to fit in". Next week I would like to have him try some other numbers to see which ones will work into his pattern.

Most students seemed to do well when they could relate the counting to the multiplication tables they had memorized. They almost all had some trouble getting over the "one hundred" hurdle. In general, the upper ability students seemed to have less difficulty no matter which number we started on or how many numbers we skipped. It became clear that some students needed to "see" what they were doing, either by using their fingers or pencil and paper, while others were able to do the mental arithmetic. Almost all students seemed to know that they had to add to get the next number. I'm still very interested in the boy who decided there had to be a rhythm to count and the boy who related this to algebra.

GENERAL OBSERVATIONS, COMMENTS:

I felt compelled to talk to the girl who was almost in tears when I asked her to count by 6's. She finally revealed that she was afraid of failing the eighth grade. She knew her grades were not good and she had heard a lot of talk about "these tests you have to pass or they won't let you out of a school." She figured this was one of those tests (since I told her it wasn't for a grade), and if she didn't do it right, she wasn't going to pass. She had moved to our district from the Chicago area and basically was scared to death. Our conversation made me realize the torment some of the students are going through that we rarely ever find out about and seldom make an attempt to correct. Next year our district is going to try to departmentalize sixth, seventh, and eighth grades, meaning I would see 180 different students a day. I'm really afraid that even more of this type of student will be "lost in the shuffle."

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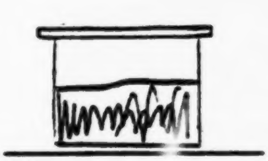

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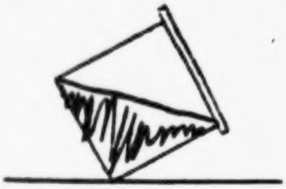

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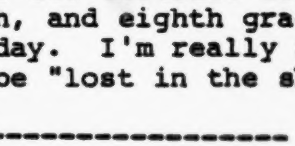

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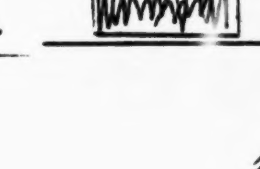

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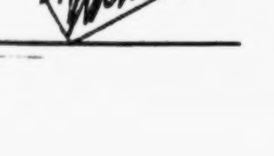

5th Grade

TRASHING THE CLASSROOM

Robert H. Bresnahan

The students in the EMH class involved themselves in an interesting math project. From an article one student found in National Geographic entitled "The Fascinating World of Trash," the other kids decided to see what materials they could collect and redeem for profit. They also discussed the environmental benefits which could evolve from their project. However, their main motivation was to collect, classify, and cash in on their idea.

They initially listed all of the materials they thought might be of value for collection. They decided the list was very limited, so they began researching other items. After compiling a more extended list, they began looking for places where they could collect these items in substantial amounts. This generated a list of places within the immediate area that would provide them material on a regular basis. The students then found places within the community which could be just occasional sources, and they established a schedule for collecting from them at specific times. They then found places within the community that would allow them to store their collected materials until it was worthwhile to redeem them.

While one group was doing this, another was researching places where the material might be reclaimed. This generated a list of locations (mostly in the St. Louis area) and particular people to work with in these centers. They then listed these on a priority basis.

The kids then organized into work groups. They established paper collecting crews, aluminum gangs, glass and steel discoverers, and generalists for more unique items (copper, brass, etc.). They also designated two groups which would redeem the items at the recycling centers, and another individual who would contact the community for new resources of collectible material.

This is an ongoing and enjoyable project, student-created and student-run. Moreover, they are utilizing mathematical skills seldom tapped before:

1. Research for materials and people as resources.

2. Utilization of telephone directory, newspapers, and individuals to provide locations for resource providers and resource collectors.

3. Mapping skills to indicate places where materials could be collected, stored, and redeemed.

4. Prioritizing redemption centers by price paid for items and by location, considering both convenience and distance.

5. Establishing specific groups with responsibilities for operations.

6. Collection of materials, sorting, weighing, listing, assigning to storage.

7. Pick-up and actual redemption of materials.

8. Accounting for costs and profits.

9. Figuring time schedules.

10. Discussion of the feasibility of opening their own redemption center for certain materials.

These kids are very much involved in this project and have been for two months. They are planning to continue this operation throughout the summer with modified crews and with schedules which allow for vacations.

Three of the students initiated another project directly from the map-making experiences for the project. They are listing and mapping the out-of-the-way lottery dealers in the local area. They believe that people will purchase tickets from these dealers to avoid the tremendous lines that exist around the two major local distributors. They feel those dealers who list with them will pay for the cost of printing so that their sales will increase. They are also planning to contact dealers in the St. Louis area if the lottery is approved in Missouri.

I have never seen these kids this excited about projects; it emphasizes the fact that if they find an activity meaningful and rewarding, there is little they will let stand in the way.

CUTTINGS

Peggy Funkhouser

Water Bottle : I tried this with a group of fours just turning five. They reacted just like the book said they would. They colored the whole bottle. They seemed aware only that the bottle held liquid in. They seemed to see no relationship between the actual bottle and their picture. I would set it in front of them and walk about. Only one child was able to correct his paper (well, he got it half full, and the line was still not horizontal). I would guess that if the child is on the verge of the next level of thought you could "help him over." But when actively teaching (!), doing our best, we were not able to change their thought process enough to get horizontal lines.

READINGS AND COMMENTS

The Teaching of Young Children , New York: 1967, Brearley, Molly. I have read Piaget many times, but I have finally decided to try to understand him. This is one of the most understandable books I have read so far. It was always difficult for me to see how they arrived at their interpretations of the meaning of children's actions. This book made that much clearer. The chapter on art was particularly interesting, because I have seen all those different aspects of children's art, but didn't know what they implied in terms of Piaget. I'm not sure I've got it yet, but I am going to keep reading until I do! I think I will try to find *The Nursery Years* by Sussan Isaacs (cited on the back of this book), which emphasizes the first six years of a child's life, rather than the operational stage. This would be of more interest and help to me.

I have included a report on another book I have read. (It is not on your list, and I am not worried about it "counting.") I found it helpful and feel it is related to the type of information we are interested in in this class.

TRYOUTS OF ACTIVITIES (AND EXTENSIONS)

I built a construction of blocks in my office, had several of the children go in and take a look, and then asked them to come out and try to duplicate it. They did not seem to have many problems with this. All of the children (four-year-olds) could do it with only one or two looks. I added blocks until there were fifteen blocks in the construction.

My original plan was to go until they had problems, and then put out paper and crayons and ask them if they wanted to make a picture or write notes to themselves to make the reconstruction easier. Since they had no problems, I just asked if they wanted to try to draw it.

They found that a 15-block construction presented too many angles and planes. They requested fewer blocks. With only five they could make recognizable drawings. With more, their drawings looked incomprehensible to me, but when I asked Shaun where this block was on his picture, or what this line represented on the construction he could readily tell me.

This activity did not shorten the number of "looks" they took to reconstruct. I tired of this activity more quickly than they did. Paper and pencil were requested at all the construction areas throughout the week. Many times the drawings meant nothing to me, but the children would concentrate intently and work for several minutes on the drawing, reconstruct, and start over again.

I worked with the "Guess Who" assignment. There were 13 children and two adults in the kindergarten classroom. I explained that I was thinking of someone in the classroom and that I wanted to see how fast they could guess who it was. The rules were that they could ask any question that I could answer with "yes" or "no."

They were eager to play, and began to ask, "Is it Jamie?", "Is it Erik?" They went on until on the fourth try, someone got a lucky guess. I chose another name and we started again. After several individual guesses, Chris asked, "What is he wearing?" I was so pleased to get a different type of question that I forgot the rules and answered, "A green shirt." Immediately they guessed that it was Chris. When I choose the next name, the first question was, "What is he wearing?" I think that this indicated only that they were aware that that question got the answer last time, not that they were aware of eliminating by using categories. This time (still forgetting the rules) I told them he was wearing shorts. That eliminated several but did not give them the answer. After a little more random questioning from those in the smaller number left, they got the answer.

I wanted to see if there was some way I could encourage them to ask categorical questions, without just giving them instructions. Since there were so few of us, I wrote all 14 names on the board. Then when they asked a question I would put an X by the name they had eliminated. I responded "good question" to each response and marked off one X, but if they asked a question that allowed us to mark off more than one name, I responded "super colossal question." When they asked me "What is he wearing?", I finally remembered the rules and reminded them that they could only ask "yes" or "no" questions.

We played a few more rounds. Any question which was successful in getting more than one X was remembered and asked again. After a few more rounds, I asked them what the difference was between a "good" question, and a "super colossal" question. They first responded that it was one that got a lot of X's. Then I tried to lead them into analyzing what sort of questions they were. We do a lot of work with categories in the preschool, so I pointed out that the "super colossal" questions all put the people into categories, and that then we could eliminate categories rather than just individuals. We talked about other categories. The first child responded using the form "They could be boys or not boys" and each child copied that form in responding: "They could wear shorts or not wear shorts," etc. We played another round or two, and the children quickly decreased the number of questions needed by asking categorical questions.

I suspected that all but two of the children were just asking questions we had discussed rather than thinking, and I switched to numbers so that the same categories would not do. I asked if they could think of any number categories. Jamie was obviously thinking hard, and then raised her hand and asked questioningly, "A 10 but not a 10?" She was following the form, but not understanding enough to make the category. They made various random number guesses and seemed to have lost the train of thought, then Brian asked, "Is it a 20's 30's 40's number?" I'm not sure he even knew what he was asking, but I grabbed it anyway. I told him I couldn't answer all of those with a "yes" or "no," but if he would ask me just one of them I could answer. He did, and I told him "No, it was not a 30's number" and eliminated a whole row of numbers. Now they were onto something, and we quickly eliminated whole rows of numbers, until we were down to the 20's numbers. Chris (one of the two that I think came closest to having the necessary thought processes) asked, "Is it less than 21?" Then he continued asking "Is it less than 22?" It took him awhile to catch on that he could skip down a few numbers and again eliminate more than one. The number was 29, and they guessed it pretty quickly after that.

To see if they could transfer their use of category questions, I again switched the focus. This time I thought of an animal. I asked if they could think of any animal categories, and they thought of a few, but by this time we had worked for over an hour, and one of the questions was "When do we quit?" The first question was "Is it brown?" Then there were a few random guesses. "Is it small" received a "no" answer, and Chris was able to turn that around and say "Well then it must be big." A few more random guesses got them the answer of "elephant." I'm not sure that they used the information received from their category questions, or if it was a lucky guess.

5th Grade

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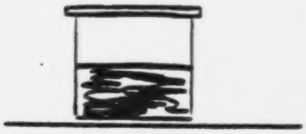

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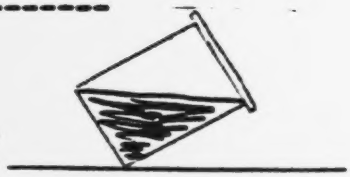

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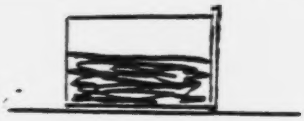

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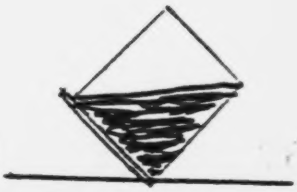

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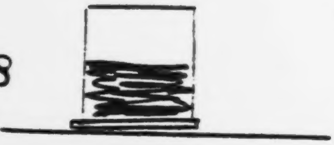


ELEMENTARY MATHEMATICS ACTIVITIES by Hassler Whitney

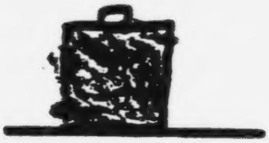
Linda Shepheard

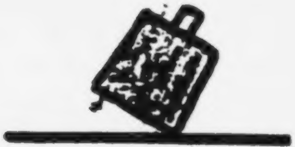
Elementary Mathematics Activities by Hassler Whitney is a very practical guide for elementary teachers. It has helped me understand why so many of my students are unable to master the advanced mathematics skills that their parents ask for. As a kindergarten teacher, I'm often asked "Is it okay for my child to use his fingers to count, add, and subtract?" I've always said yes (after looking around to be sure our first grade teachers weren't listening). I've known this in my heart to be an acceptable thing, but I also hear other teachers constantly complaining. I have made bead strings and can see a real understanding taking place in my class. I intend to begin the first week of school next year with these bead strings. I use only ten beads, five of two colors, perhaps I'll be able to enlarge them next year as the children and I are more comfortable with them. I found myself telling parents who had asked what to work on over the summer that it does not do any good for children to know number facts if they cannot use them in life situations. I particularly like this quote from Whitney, "Teach the children and they will learn what they are supposed to do; help them to find their own way and they have the power to go further." In other words help them to DISCOVER!!!

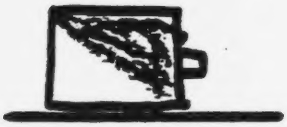
As I think back on my own school life, I realize so many things about teachers and hopefully I'm not nor will ever be that way. I was always the youngest child in my class with a December birthday. Consequently, entering when I did while still only four years old, school was never easy. In fact it was d--- hard. It was a totally negative experience. Hassler Whitney's section on remedial help really hit home. It is so true, painfully true. I always try to remember my experiences when dealing with my students. I was glad to see someone understand those unhappy feelings.

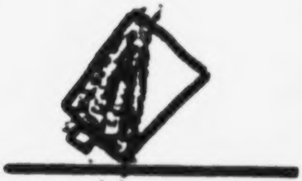
Overall, this book is a first-rate addition to my professional library.

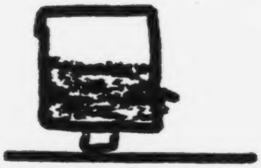
Grade 1











WHAT DO I DO NOW?

Alfred G. King

I received most of my formal education right here in southern Illinois. I was taught to teach in southern Illinois. I have done all of my teaching in the southern Illinois area. These are significant statements as I am now taking a class in that same area. This has surfaced doubt as to my proficiency as a teacher. The class is ELED 515 with Tom O'Brien.

Prior to meeting Dr. O'Brien, I was content that I was an excellent teacher. I teach Math and Science in the traditional St. Louis manner (structured classes, lecture, and drill). This (to me) is still the best way to teach math. The doubt that hangs over me and half the staff at my school initiated from one of Dr. O'Brien's classic statements "do more with the idea." Let me try to bring you all the way from the beginning.

My reputation for class control precedes my entering class with the students. Students are warned prior to entering my class that I am strict. It took many years for me to establish my discipline procedures. I am a believer in assertive discipline procedures in that I reward good behavior and am critical of unacceptable behavior. In other words, "Do as I say, when I say it, and we will get along fine." There is nothing wrong with that philosophy because I only tell you to do what society and the school system tells me to tell you. Can you see from the above garbage statement that I am already limiting creativity because I am thinking for my students?

Dr. O'Brien gave us an assignment to have our students play tic-tac-toe backwards (that is, three-in-a-row is a loser). To do this I had to remove some of the structure from my class. I did as I was instructed and lost class control. I vowed that I would not do that again and I came back and shared the experience with Dr. O'Brien and class. Between my classmates and Dr. O'Brien, I was persuaded to try another exercise with my students (How many ways can you make 5 sticks?). I went back to my students with a new box of primary number sticks. I gave the instructions to a class of 28 seventh graders. Twenty-four students worked individually and four worked in a team. I observed somewhat amazed. The individual students were working smoothly while the team was disorganized and bickering.

It hit me like a ton of bricks that that was my fault. I had created monsters that could not work together. They couldn't work together because all of their educational life, teachers like me have packed these kids into overcrowded classrooms and have rewarded them for individual work and penalized them (often severely) for working together.

I had never approached this issue before and I became obsessed with finding a solution to this dilemma. I brought the problem back to Dr. O'Brien's class where it was addressed in great detail. Many suggestions were given. We agreed as a whole that this was a severe problem of our existing education system. After all, how can you function in society if you cannot work with your peers?

Now this is where it gets tricky. I asked a fellow teacher to take my most "productive" eighth-grade Science class and instruct eight kids in small groups of four. No problem, said this teacher (a successful 18-year teacher with a Masters plus 30+++). Within five minutes the class was completely out of control arguing among themselves like there was no tomorrow. My coworker was beside herself. She immediately knew the problem. She stopped the activity and, being the professional that she was, had an open discussion with the kids. The kids were angry but honest. They criticized the teacher for making them work together. After all, this was not gym. The students wanted to be graded on what they did individually. B.F. Skinner would have been proud of our kids' behavior modification.

My coworker and I felt that this problem was a severe one. We challenged other teachers in our building to try activities involving students working together. We started challenging teachers on Wednesday. By Friday of the same week, the lounge was a den of depression. We had awakened to the idea that we were unintentionally causing mistrust. We were limiting creativity. We were causing severe damage to our kids, damage that could not be easily repaired.

Now what in the hell does all of this have to do with teaching kids math and problem solving? If you don't know by now, don't come into or stay in the teaching profession.

Grade 5

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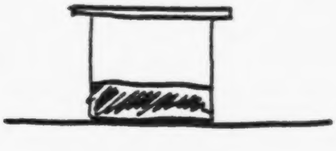

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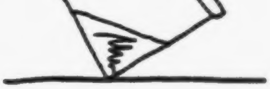

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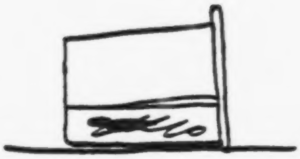

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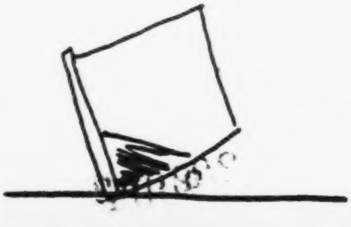

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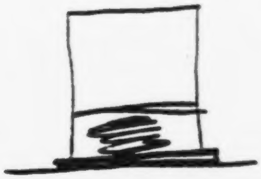
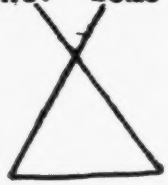


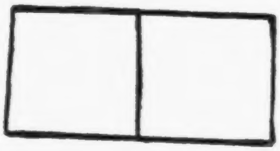
FIVE STICKS

Linda Shepheard

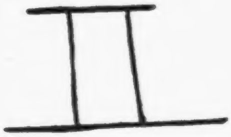
I find "Five Sticks" by David Fielker (found in Readings in Mathematical Education , Geometry selected by Marion Walter and newly published by the Associaton of Teachers of Mathematics (UK)) to be a good exercise for the classroom at all levels. The children are asked to use five sticks or any suitable substitute and to "do something" with them. This is a very open question. More finite questions may be necessary for older children. I did this with my kindergarten class and received a variety of formations, all of which bore resemblance to a familiar object and so named were by each student. Some examples follow:



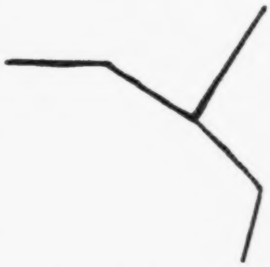
Teepee



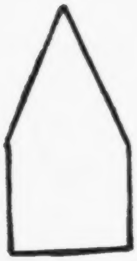
Window



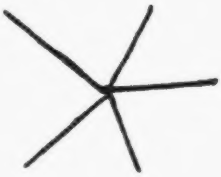
Airplane



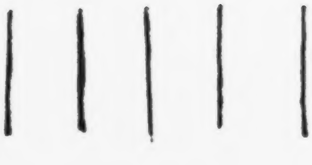
Spaceship



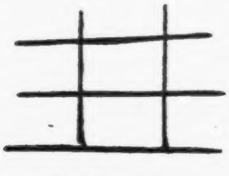
House



Starfish



Bridge



Gate

I find these results to be exactly what I expected from this age. I was surprised at their speed in coming up with ideas and their joy in doing it. Some children did not wish to stop and did only when their bus arrived. I wonder how far up the age scale I would need to go to attain more abstract results. At what age do they pick up the sticks and form three dimensions?

Can exercises like this one give a better picture than standardized test results of how a class (or an individual) operates with mathematics? David Fielker's exercise on the intersections of these sticks would do just that. Can children manipulate without having been taught theorems as suggested? I suspect so.

Most children begin with a square. What to do with the fifth stick becomes a problem. Asking the children to find answers to questions posed to them is active learning and therefore more meaningful to each child. The following questions were gathered by Donna Logsdon in St. Louis and John Trivett in Chicago.

Can you move the fifth stick so that its ends are touching adjacent sides of the square?

Move the lower end of the fifth stick from a corner of the square along the side in several steps. How does each move affect the area of the triangle?

Mark a point on the fifth stick and sliding the stick so that its ends touch the sides of the square, trace the locus of the point. What shape is it?

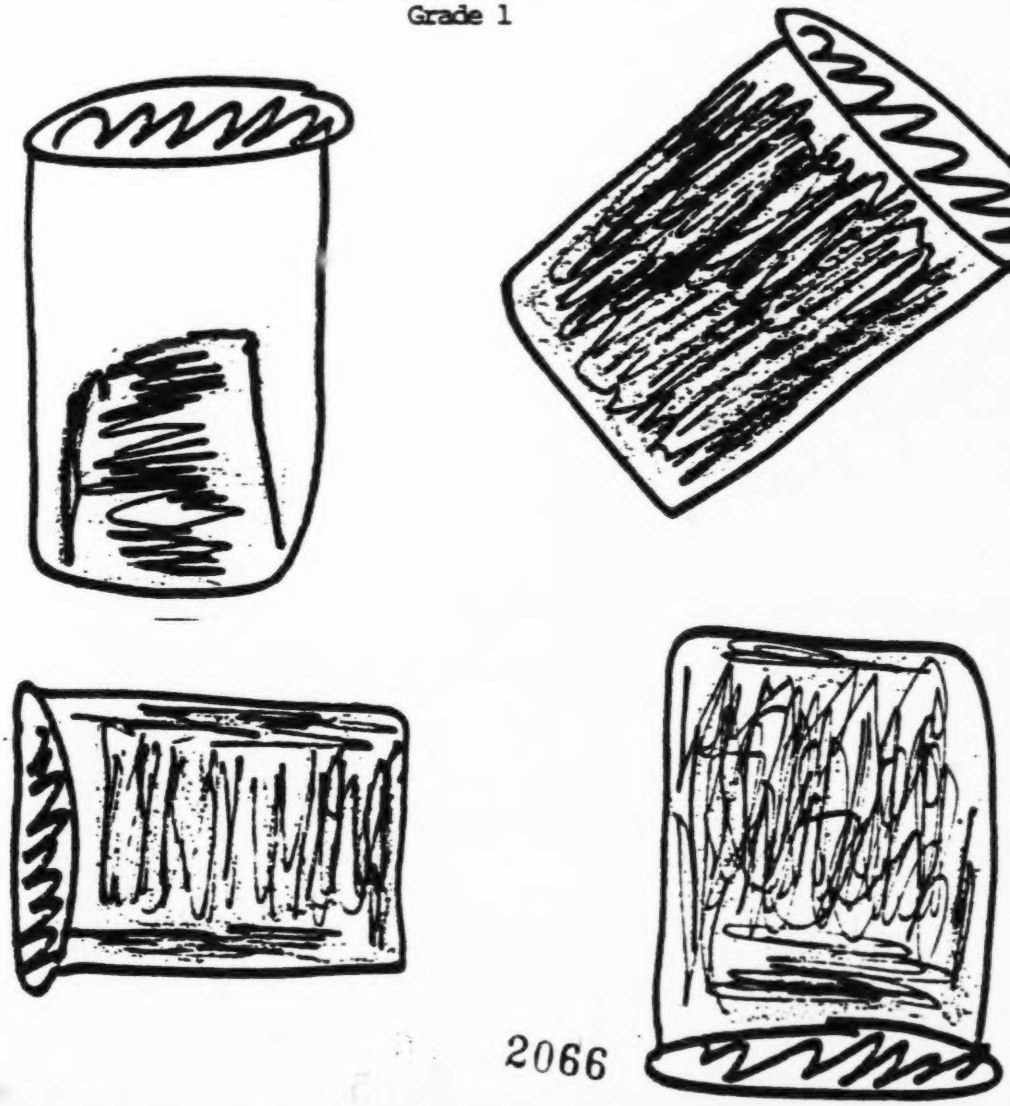
Can the fifth stick touch three other sides? Where would you place the fifth stick to make 1/4 of the square, 1/2, and so on? How many ways can you find for each?

These are not all the questions asked. I'm sure teachers can draw up many more.

I want to end with a quote from the David Fielker article, one that I find very thought provoking.

"Teacher's sessions, like pupils' lessons, are usually finite but in any case it is probably better to end with a collection of unanswered questions, about which people will continue to think, than to 'round off' things cosily with some 'agreed' conclusions, or a summary by whoever is conducting the session. And perhaps that too carries a message for the classrooms."

Grade 1



CUTTINGS

Kathryn D. Rudolph

Hidden Chips : She pointed to each chip as she counted them. Kerchetta needs objects to count. She had not brought anything with her to count by, so she tried to figure it out on her fingers. She came up with 3 hidden instead of 6. I showed her the six, then had her hide her eyes again. I moved the chip and covered 6 again. She counted the chips left. She realized she had gotten the wrong number using her fingers so she looked around to see what she could do. A newspaper was laying on the table beside her. When she saw it, her eyes lit up and she grabbed it. She counted 13 letters off the headline, then she counted 7 letters off that. She covered all of those with one hand and counted those left, coming up with the right answer of 6.

OBSERVATIONS OF CHILDREN'S THINKING

I was working with Kerchetta again today. We were doing addition of 2-digit numbers. She was counting on her fingers to get the answers but she kept coming up with the answer being one number short. If the answer was 6, she would have 5. I watched her count them. She was starting holding up 3 fingers and then counting the last finger as the first one of her next set of three. I had her hold up only the number of fingers that she needed to add on, then start with the top number and count on the number of fingers she was holding up. We did this several times with me telling her to hold up so many fingers and where to start counting. All of the sudden she looked at me and said, "Let me do it myself." I did and she got the rest of the answers right. I felt like a little light had lit up in her head and she had figured out what to do with her fingers.

I don't remember ever counting on my fingers to get the answer. It may be that it was considered such a "no-no" in school that I have blocked it out. I don't know, but it has made me learn how to do it all over again. When I saw what Kerchetta was doing, I finally figured out what it meant to count on and so forth. I had read about it and seen it, but I really didn't realize what was going on until I saw that. I think a little light bulb went on in my head too.

WHAT DOES "EQUAL" EQUAL?

Kathy Hagen

Often our teaching of math assumes that some very basic concepts are understood. My nine year old demonstrated this fact to me very clearly.

Most fourth graders are familiar with equations such as:

$$6 + 1 = 7$$

$$6 - 2 = 4$$

$$2 \times 2 = 4$$

$$18 / 3 = 6$$

We concern ourselves with the child learning what the mathematical process or operation is. While this is of course important, we may be ignoring a concept that is misunderstood by children.

This problem is the basic question of what the = sign means in any problem.

Upon asking my daughter what the sign means in the problem

$$6 + 1 = 7$$

I was told, "After the =, you put the number seven." The sign only had meaning in relation to the process she was working with in a particular problem.

I decided to try to help my daughter discover what she was actually doing in these problems besides finding an answer to the sum of the two numbers, i.e. making both sides of the equation equal.

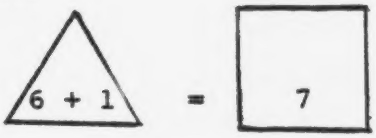
Instead of using the problem 6 + 1 = 7, I changed the problem to:

$$\triangle = \square$$

By using symbols, I eliminated the numbers. She could no longer give me a numerical answer but had to look at the statement as written.

I asked what was being said about △ and □. My daughter told me that they were equal, the same. This was the first time she had used the word "same" in her definition.

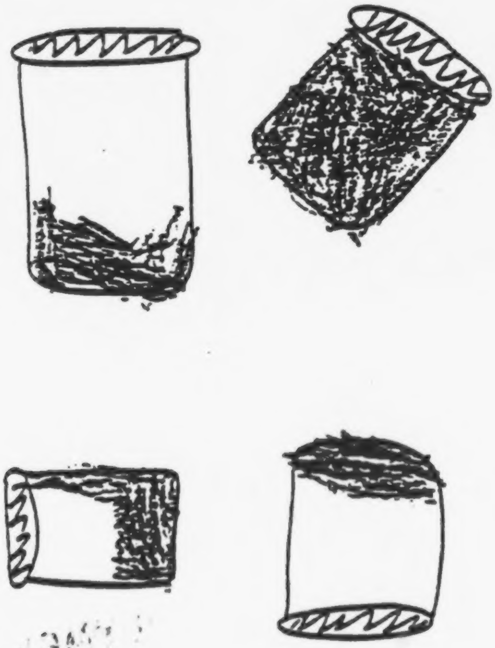
I then substituted numbers back into the problem, and asked again what the = sign meant.



I was told that "the 6 + 1 and the 7 were the same thing."

She saw the sameness of each side of the equation. While she could answer 6 + 1 = 7 before, we were both pleased that she was now understanding the statement made about the two sides of the equation.

Grade 1



AN ADAPTATION OF THE WHEEL OF FORTUNE

Robert H. Bresnahan

A popular game show which has netted a tremendous following is "Wheel of Fortune." The game goes something like this: Contestants bid for money to purchase prizes showcased during the show. They do this by guessing concealed phrases, quotations, things, etc. The words are uncovered when the contestants guess the letters that make up the words. Each correct letter allows the person to spin the wheel for more money and another guess. Within the wheel are two breaker spots: "Bankrupt" takes away everything that a person has won up to that time and "Lose a Turn" gives the wheel to one of the opponents.

The game really involves both players and spectators. Indeed, it is one of the few television games that can catch the attention of an entire barroom or living room.

This game can be readily adapted to teach something about mathematical symbolism, place value and inference. Instead of words and phrases being hidden, try equations such as $22 X 3 = 66$ or $4 + 9 = 13$.

The game would be played with two players. The teacher would set the problem by indicating a number of spaces which would conform to the hidden equation (six spaces, for example, would be used for $2 X 9 = 18$)

The game can have many variations. More than one operation sign can be used, for example, or decimals or fractions. The difficulty of the task can be matched to the individuals playing the game.

I have used the game with special education classes and have found it a lively competition.

CUTTINGS

Donna Smargiassi

I dumped a pile of marbles on the floor and had a three-year-old girl count how many there were in the pile. She counted all 16, just pointing to them. I then added one more and asked, "Now how many?" She hovered over the marbles like she was counting to herself and then said 17. I added one more and she said 18. Next I took 9 balls and she counted 9, then I took one away and she started to count again and then said 8. This little girl has a very large vocabulary and remembers things quite well.

My next little girl was only 2 years old, but you would never believe it. She can talk your arm off and is very quick. I had a very unusual experiment with her. I put a pile out in front of her that contained 7 marbles. She began counting the marbles--it appeared that she was just doing random pointing as she counted. She never touched a marble but went all around the marbles. She stopped and said 7. I added one more and she did the same thing and said 8. I noticed on 8 that she appeared to be going around the outside of each marble. So I put seven marbles in a circle and asked her to count them. These marbles as well as the others were of different sizes. She again went all around the circle and stopped at 7. When I tried it for a fourth time with a student-teacher present, she said 5 to 9 balls. I waited until the teacher left and asked her to count for me again. She seemed to count the big marbles first then moved around to the others, but in a random way; but she gets the answer. I just did it again and she got the answer again!

I know a girl who is in the fourth grade. It took her forever, it seemed, to learn her multiplication facts. It seemed that she just couldn't do the computation. I wonder now if it might be because she really didn't understand what she was doing? That it didn't have any real meaning to her. How many other things do we "teach" kids and then can't figure out why they don't understand it. There's got to be more meaning to things before you will want to learn them.

A little boy was being shown a flash card with 40/8= ☐. The teacher asked him for the answer. He replied that 40 /8 was 5. She asked if he would like to tell how he got that answer. This was his response: "Well, 8 x 10 is 80 and half of 80 is 40 so half of 10 is 5!" This little boy was 5 years old. I was really amazed to hear his logic but it does make sense.

READINGS: Coercion in the Classroom Won't Work

My first thoughts after reading the first paragraph was: Are they still doing that? They did that to me? I especially liked the line that education to authoritarians is not a means to help each child to mature but a series of hurdles over which everyone of no matter what capability must jump. How can a person who follows this believe they are actually helping a child? How can they believe they are teachers?

I HAVE LEARNED THAT . . .

Carol J. Klekamp

We need to do more child watching because we can help a child only after we have observed him and have found out "where" he is in his thinking and learning.

Child watch can lead to a better relationship between the child and the teacher, providing that the teacher lets the child know that there are no right or wrong answers and that he is free to do the activity in the manner that he wishes.

Children are different from adults in their thinking and learning. Therefore, we should be patient with them and not kill their natural curiosity and desire to learn.

Children learn in different ways and what works for one child may not work for another.

Children's mistakes are the result of incorrect procedures, but the procedures are usually systematic.

Almost every child possesses hidden strengths and it is our job to look for them. In other words, we should never give up.

Math can be fun and exciting depending on how it is approached and it is up to the educator to help get rid of the anxiety that is usually associated with it.

Learning should be active rather than passive because children learn better and remember more by doing than they do by listening.

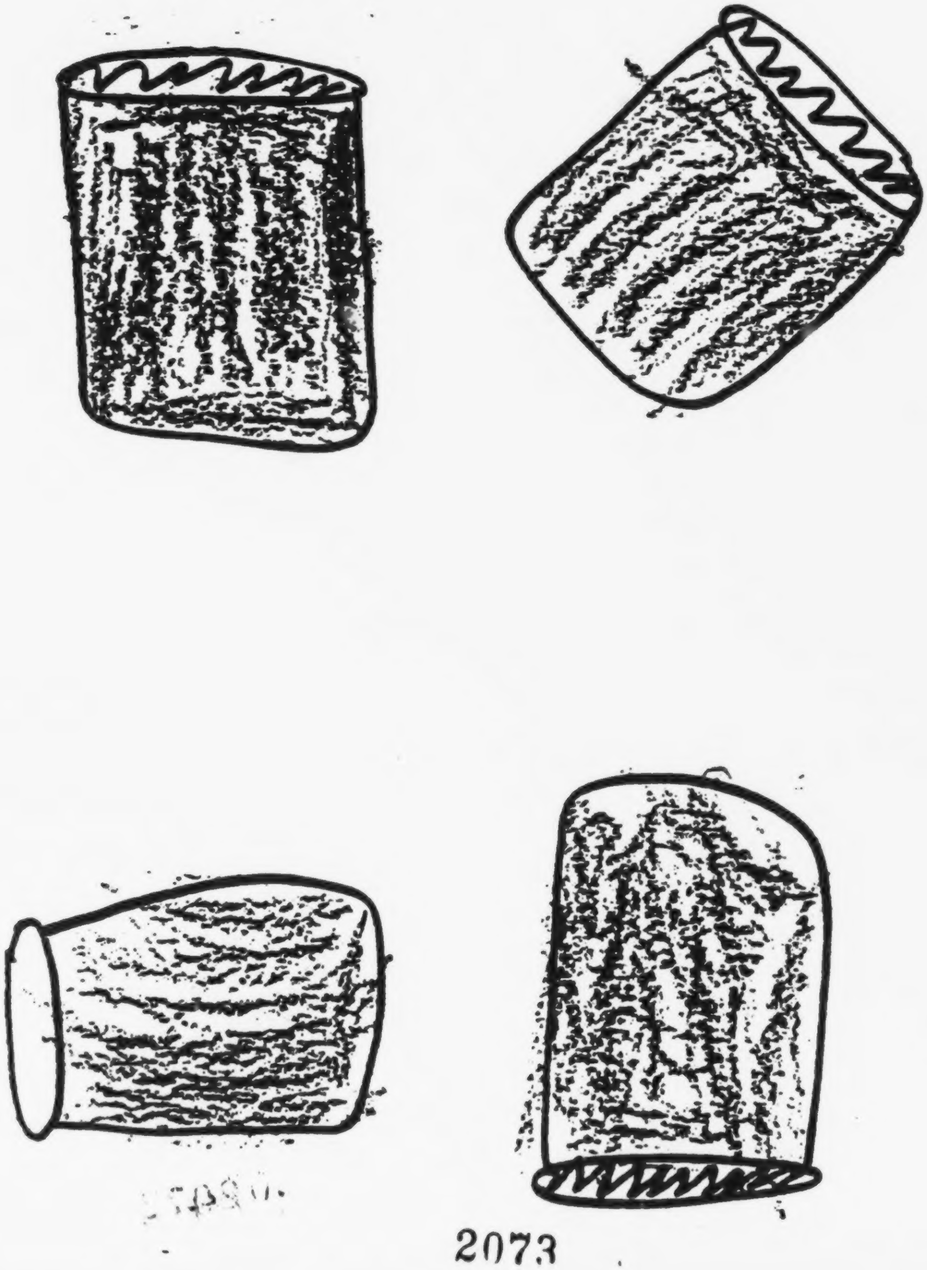
We need to teach children not how to memorize but, rather, how to organize and look for information. Only then will they be equipped to solve the problems of the future.

There are many great computer programs which allow children to become participators rather than spectators.

We as teachers do need to set up a supportive network such as SEEDBED, because teaching is a lonely profession and everyone seems to be putting it down.

We need to share all of the great ideas and activities with each other so that we can become more effective teachers.

Grade 1



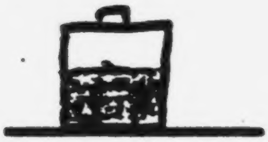
WHY I AM A MATH ANXIOUS PERSON

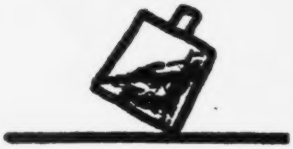
Donna Smargiassi

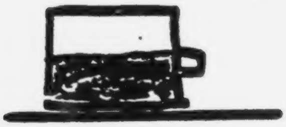
"Donna, how many did you miss on your fraction paper?" "One", I said. "Okay, now let's give your paper to the person next to you to double check it". A few minutes passed and the person checking my paper suddenly said, "Mr. Smith, Donna said she only missed one but I count twenty-one!" That episode was the turning point in my math life. Up to that time I did fairly well in math, but after having to write apology letters to my classmates, teacher, and a letter informing my parents of what I had done, I changed my views on math. I grew to fear math, then hate it, yet I kept taking math classes during my high school years because I didn't want anyone to know that I was scared of math. As it turned out, I caused myself more misery than I had expected. I would come home at night and cry myself into a state of confusion because I couldn't figure out the area of a parallelogram or multiply two polynomials. That incident in fifth grade certainly had its effect on me.

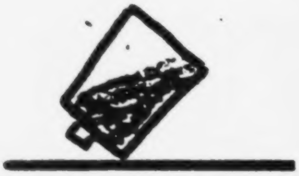
I look back on the episode and wonder what would have happened if I had asked for help in solving my fractions, if maybe I would have approached math in a different manner. I know that my mother wishes that I hadn't had that episode because she was the one who had to listen to me rant and rave about not understanding my algebra and geometry. I not only made math a miserable experience for me but for her as well. Not wanting to appear dumb--that is what it all boils down to. I didn't want anyone to know that I didn't understand, so I cheated on my paper. How many times do we do something like that to our students? How many times do we make them feel dumb when it is really us who are at fault? This is a very important issue to me. If all it takes is one traumatic experience to foul a kid up for the rest of his life why do we stress the 100% paper, or the perfectly diagrammed sentence? Why can't we teachers be there to help, to teach/to encourage growth? My life was changed for good because of a teacher's inability to stress those things. I am going to make sure that I as a teacher never do that to a student of mine. They are there to learn and I am there to help them learn.

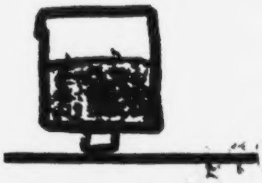
Grade 5











CUTTINGS

Linda Shepheard

Our child-watching task was to present a set of items, cover some, and ask the child to tell how many were covered. I expected to receive "I don't know" most of the time. I was mistaken.

When showing a set of 5 to a group of 7 children, all but one counted without touching each item. When I covered 2 or 3, each came up with the right answer. I always asked how they knew. Their answers ranged from a complete description of subtraction to "I just guessed."

I then presented a set of 6. I did this because it takes both hands to visualize this and this is a big obstacle at this age. I came up with correct answers. It was apparent they were counting to themselves to get the answers.

I then jumped to a set of 10. Five children were presented with this. Two had to recount to identify 10 numbers. Only the child who is insecure touched and counted.

Child #1: I covered 3. She said I had 4 covered because there are 6 left.

Child #2: Had the right answer but didn't know why.

Child #3: She first counted 8 and had to recount. I covered 4. She said I covered 8 and answered "I don't know."

Child #4: He touched and counted. I covered 4. He said I covered 6 and answered "I don't know".

Child #5: I covered 3. He answered correctly and said, "you left 7."

The child-watching task was a continuation of the hidden chip task. Doing this game drew a lot of attention from the class and I found out to be careful because those watching would give away the answer. I found the results more interesting than the first time I tried it.

Darius : I used pennies. I began with 10. He counted them by touching 3 times before he arrived at 10. I hid 3, when asked how many he said "three, 'cause you took away 3." The last part was in response to "how do you know?"

I then hid 5. He said, "Four 'cause after 3 comes 4."

Kevin : I hid 5, he said "Three 'cause there is no more 3." I noticed that as he touched and counted, the "3" penny was one I had hidden. The fact that this is the only one he noticed was missing is important. His number concept is limited. He has not reached the degree of concept development for subtraction.

Angie : She had been watching Darius. I hid 4. She said "Five, because after 5 comes 4." I believe this child has the beginnings of subtraction but the concepts are muddled. She touched and counted 5. Perhaps understanding that subtraction is going backwards on the number line she came up with 4.

Mary : She didn't count them. She assumed that I started with 10 as I had with the others. I hid 7. She said, "Five, 'cause there are 3 left." Her number ability is somewhere between 5-10.

At this point I switched to large blue beads. I wanted to see if the size of the objects would be a factor. Each of the children had been watching the "game" with the other children.

Michelle : I began with 10 beads. I hid 4. She said "Three because I counted 7 (pointing to the beads showing, she did miscount them) and then I counted 3." She had counted by 1's from 7 to 10. She had a good procedure for her age, just computed improperly.

Tina : Counted 11 and recounted to get 10. I hid 7. She said, "four, 'cause I counted them." She didn't seem to understand the question, "How many are hidden?" even though she had been watching the group.

Kari : She acted very reluctant to do this and I told her she did not have to but she continued. I asked, "How many are there?" Without counting she said "Seven." "Why don't you count them?" She did correctly. As I hid them, she peeked. She laughed about it and walked away.

This week I completed the book FREEDOM TO LEARN by Edith Biggs. This book is full of rich ideas, deep thoughts, and creative procedures.

Emphasis is shifting from the teacher to one-who-makes-it-possible-for-others-to-learn. Hopefully, this is a good working description for a teacher. Giving answers and solutions to students before they have a chance to explore and discover is depriving them of proper development in many areas. Creativity is never developed through information on a ditto sheet.

As I read through the chapters listing items necessary for active learning, I realized my classroom has many of these items. We have a reputation in our building: "If you can't find it, ask kindergarten." As I observe my class better in center time I'm becoming aware that they are discovering more than I realized. This makes me happy. I entered the master's program to further my teaching abilities. I was getting stale or so I thought and needed "new blood." I suppose being in kindergarten allows me to be more flexible at least in my setting. I will say that because of this class I have "observed" my class in a deeper sense and I'm not totally displeased.

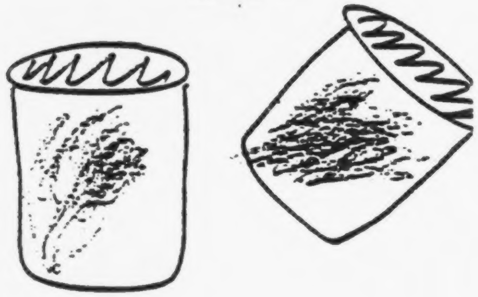
I'm still concerned with moving from the English (that is British) schools to American. The home societies appear to be so different. I see problems ahead in trying to apply the techniques used in Britain to our schools. How do you get administrators interested? They seem to be consumed with Iowa test results or any standardized test results. If scores are suppressed in primary grades, even though they show greater improvement later, how do you justify this change? Maybe I'm too nearsighted to see how we can change totally without problems. Even if one teacher did make the change, what about next year's teacher?

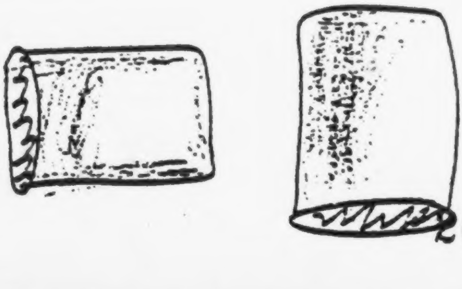
The statement "It may not be the child who fails. It might be the teacher who fails when the child does not achieve according to his capabilities" puts the learning process back on the teacher. It is their responsibility, their sole responsibility. But, as pressures are put on us from administrators, parents, other teachers, and community, we do lose sight of this sometimes. We should be reminded of this every school day.

The book talked of parent involvement. Our school district takes advantage of this resource. I have parent volunteers in my class daily. Not only can I do more activities with my class, I have parents talking about the program with an honest understanding of what is going on in my classroom. These parents learn to understand the importance of the little pieces of knowledge. They realize internalized knowledge is much more important than "a group of letters makes this word." They learn that children do not learn at the same time or rate. I am a believer that this wealth should be tapped.

The book serves as an inspiration for a long-term goal. I see many obstacles along the way and probably an integration of the present mode of teaching with active-based learning.

Grade 1





RIGHT AND LEFT BRAIN FUNCTIONING: DO WE TEACH TO BOTH?

Bonnie Enos

The research into the theory of left and right brain functioning is interesting. The left side of the brain is said to control verbal, logical processing, while the right side of the brain controls the spacial, intuitive thinking. Although there is some controversy over the existence of an actual split in the brain, it does seem apparent that two different modes of thinking do exist.

Most of us are aware of a two-sidedness of human nature. We understand the difference between thinking and feeling, intellect and intuition, objective analysis and subjective insight. When the man at the racetrack studies the racing form to check all the variables but makes the final selection on a hunch, the brain is processing the information in two different ways.

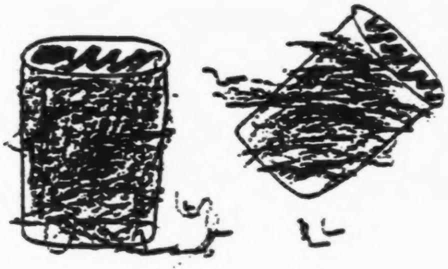
The left-mode analyzes, counts, marks time, verbalizes, plans step-by-step, makes judgments based on logic. Our schools are structured primarily in the left-mode. Teaching is sequenced. The main subjects are verbal and numerical. Time schedules are followed. Seats are in rows. Learners converge on an answer. Teachers give out grades. And everyone feels that something is missing.

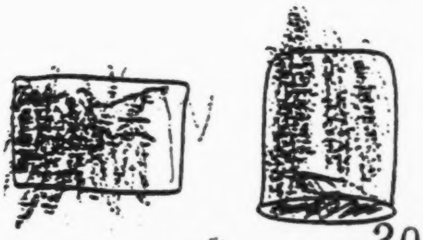
The right-mode of processing information is when we have mementos when "everything seems to fall into place." When this occurs people often exclaim, "I've got it" or "Ah-ha, now I see the picture." It is when the parts are seen as relating to the whole. Although we as teachers seem to value these skills (imagination, visualization, perception, spacial skills, inventiveness, creativity), we rarely teach them. We apparently hope they will be a natural consequence of verbal and analytic training.

Many teachers do not really understand right-mode thinking well enough to teach it. The following article is a series of exercises to help you and your students feel the shift to right-mode thinking. Once you have the experience and understand the total way we process information, many new teaching strategies become apparent.

If we as teachers can develop both modes of thinking in our students, they grow with a more complete and interrelated educational process. How can the right-mode of thinking be incorporated into the teaching of math, science, history and other subjects? What other areas of learning should be added to our curriculum? How can the child get a total understanding?

Grade 1





CUTTINGS

Nancy Sweet

I gave each child 5 popsicle sticks and asked them to use all five to make something.

I was surprised at the variety of patterns. Only one child made a "house." Several made designs that included sticks standing on edge rather than flat. Out of 22 students I had 19 different designs.

After working with the sticks and patterns for a while, we discussed the term intersection. We then began working with the sticks one at a time experimenting to find the number of intersections possible with one stick, two, etc. One of my students did discover the pattern after we had 1-4 on the board and predicted correctly for 5 on.

Most found it difficult to get all the possible intersections from 4 on, though about six of the students could consistently achieve it.

They also discovered immediately (unlike their teacher!) that the minimum number of intersections would always be one.

COUNT BY 3'S

The first child observed began at 0:
0,3,6,9,12,15...18,21,24,27,2...,30. He counted from 0-15 quite confidently. Upon reaching 15 he slowed down considerably and hesitated between each answer. After 27 he said 20...and then corrected himself and went on to 30. I stopped him there and asked him to count by three's beginning at 29.

29,33,36,39,43,46,49,53,56. There was a great deal of hesitation between each answer, and he immediately put his hands behind his back. I believe (saw slight movement) he was counting on his fingers.

I stopped him at 56 and asked him to begin at 86:

86,91,94,97,100,103,106,109,112. He said this slowly also, said 98 after 94 but corrected himself and changed to 97. After he reached 100, he went fast.

The second child said the 3's from 0 rapidly with no hesitation:
0,3,6,9,12,15,18,21,24,27,30,33. From 29 he said the numbers with little hesitation: 29,32,35,38,40,46,49,52. From 86 he also counted with very little hesitation: 86,90,93,96,99,103,106,109,112.

NOTES ON MATHEMATICS IN PRIMARY SCHOOLS by Members of the Association of Teachers of Mathematics.

I found the chapter on number patterns interesting especially since we had worked with the same idea in class. I intend to provide my children with some paper and have them construct their own chart.

I was fascinated by the pages that appeared throughout the book which seemed to be reports on interviews with or activities of children. One such page was "Inventions" by a group of six-to-seven-year olds. There were seven problems (story) written by children. I can't believe how complex the problems were for children of that age level. I would like to know more about the students and the circumstances of writing the problems. It astounds me that children of that age could compose such complicated problems. If this is the result of average children in regular classes, obviously they are doing something very right in their math programs!

I was interested in the chapter on graphs. (What are first-year infants?) I have done some work with graphs with my third graders and find that most of them are able to construct a simple bar graph and a simple pictorial graph. The arrow game discussed in that chapter sounded appealing. I want to try that one in class too. The trouble with taking this class in the spring is that there isn't enough time to try all the things I'm reading about! I'll have to wait until September for some of them!

I read the section on noughts and crosses and confess that I never remember giving much thought to strategy when I played tic,tac,toe. I guess I must have thought some since it seems most games ended in a tie--I didn't lose at least. I guess this is the basis for the initial game we played where we put rows and columns of dots and then drew lines to connect them. The person who completed a square could put his initial in it. The object was to have the most initials. This game is also listed in the book under the section on strokes.

I was intrigued by the chapter on like and unlike--especially the introductory paragraphs on reading. I never thought about the position of the word on the page affecting the perception of the word for the child. I realized lower case and upper case letters are different for the children--that's obvious. But the idea that reading a word on a line by itself and then seeing the same word later in the middle of a paragraph presents a different picture to the child is amazing to me.

The activity suggested near the end called "Write about a number" is another interesting one that I've added to my list of things to do!

Another activity I'm going to try with my students is one in which the students compose a true story:

In my house I have one ______ .
In my house I have two ______ .
In my house I have three ______ , as far as they are able to go.

I gave each child a sheet of graph paper (1/2-inch squares) and had them construct a simple number chart--1 in blue, 2 in red, 3 in blue, 4 in red, etc. from 1-100. It was interesting to watch the different methods children used for constructing the chart once they understood the pattern. Some immediately began doing all the blue columns, then all the red; a few did skip writing 1-3-5-7, etc.; while others did 2,4,6,8, then went back and filled in the blue numbers. A few laboriously wrote each number in sequence alternating the blue and red crayon every single number.

Once the chart was constructed we began to look for patterns. The children really seem to enjoy this and have found some patterns I hadn't found. We aren't finished with this one so I'll write a complete description when we're through.

Following are discoveries the children made when we began looking for patterns on the chart. I listed them in the order of discovery:

1. All the blue numbers are odd and all the red numbers are even.

2. The last column is counting by tens. After some discussion, they decided all the columns are counting by tens.

3. The colors alternate.

4. All the numbers in every column end alike--all 1's, 2's, etc.

5. All the rows are counting by 1'.

6. If you start on the left, and go diagonally, all the 1's digits are counting by ones.

7. You have to count by 2's to get from one red column to the next.

8. In the columns if you go down, the tens' place is counting by 1's.

9. If you start on the right and go diagonally, you are counting by 1's backwards in the ones' place.

10. You can count by 5's using the 5 and 10 column.

11. In every row the 1's place is the same 1-0.

12. If you start at 11 and go diagonally to the right, every number is a double--11,22,33,etc.

13. If you start at the 9 and go left diagonally, you are counting by 9. After some discussion, they discovered all columns are by 9's diagonally.

14. Pick any number in a first row. Then go to the second row of that column and count down that number. Go to the beginning of that row. It is a reverse number of the one you started with. Example: Start at 4, move to 14, count down 4 to 44, beginning number of that row is 41 (reverse of 14). Put one finger on the row and one on the column. As you move down and across each number pair is reversals--14,41;24,42;34,43;44,44;45,54,etc.

15. The sum of the digits progresses by one in every column.

16. Pick any number. Add 1 and it equals the next number.

17. If you start at 1 and go on a diagonal, the sum of the digits is counting by 2's--1,3,5,7,etc.

18. Start at 11, add the digits and to up 1 diagonal for the answer. On the next row, 21, add the digits and go over 2 diagonally for the answer. On 31, go over 3 diagonally for the sum of the digits.

19. If you start at 9 and go diagonally, you're counting by 9's. In other words you multiply 9x2, 9x3, 9x4, etc. to move diagonally. If you start at 8 and move diagonally the pattern is 8x2 + 1, 8x3 + 2, 8x4 +3. That is an add pattern of +1. For the 7 column the add pattern is +2, for 6 the add pattern is +3, for 5 the add pattern is +4, for 4 the add pattern is +5. For 3 the pattern seems to be +6 and for 2 it seems to be +7.

20. Count by 9's on a diagonal to the left. If you start at 8 and skip one block, you can count by 8's on diagonal left. If you start at 7 and skip two blocks, you can count by 7's on diagonal. If you start at 6 and skip three blocks, you can count by 6's on diagonal.

At this point I stopped collecting data. However, the children were so enthusiastic they continued to find patterns and tell me about them. Next year I am giving the children some poster board for their charts so that they will be more substantial. We're going to begin early in the year to explore the chart and keep it handy in our desks for easy reference.

0	1	2	3	4	5	6	7	8	9
10	11	12	13	14	15	16	17	18	19
20	21	22	23	24	25	26	27	28	29
30	31	32	33	34	35	36	37	38	39
40	41	42	43	44	45	46	47	48	49
50	51	52	53	54	55	56	57	58	59
60	61	62	63	64	65	66	67	68	69
70	71	72	73	74	75	76	77	78	79
80	81	82	83	84	85	86	87	88	89
90	91	92	93	94	95	96	97	98	99

YOURSELF AS A RESOURCE

Shirley A. Casey

I've met a teacher here through a girl who works at the deli. He teaches kids who are in a work/study program that involves their going to school 1/2 day and working 1/2 day. He has these kids for two hours every morning and they talk--about all kinds of things that could fall under the heading, "Successful Living." Basically what they're doing is group/collective problem solving--but real world problems. Anna says they've talked about everything from direct work-related issues like forms, taxes, skills, etc. to handling stress to health problems to religion (public school!). The teacher insists that every person contribute so it truly is a group/collective approach.

Anna says it's just about the only class at the high school that no one cuts or skips. She constantly talks about how much she's learned.

When I spoke with this teacher, I asked a lot of questions and basically what he said was this: "Most of these kids are smart enough to know that they aren't learning anything useful in most of their classes. I require that they find a job and get themselves hired and then we talk. The things they need to know surface and I want them to see one another and themselves as resources rather than the teacher.

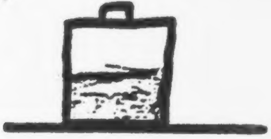
"I sit at graduation every year and look at the graduates. I see the straight A kids and think all they really know how to do is go to school and I worry about them. But then I look at my kids.

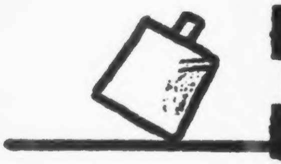
They've survived school so if they ever feel the need to go back, they'll do all right. But they know so much more. They're strong. They'll make it because they recognize and believe in themselves as able resources. They'll make it! Very few if any of them will make shrinks rich and I'd bet there won't be any suicides among them."

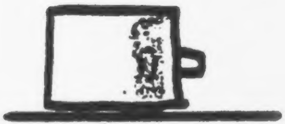
I asked how he gets by with working the way he does. He said the administrators see these kids as lost causes, but keeping them from dropping out keeps the body count and the state aid up. So they let him do what works in his way.

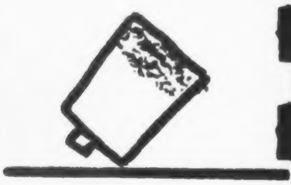
So I raise the ethical moral question. Can we continue to raise hothouse students who won't or can't transplant? And can we continue to train our brightest students for obsolescence?

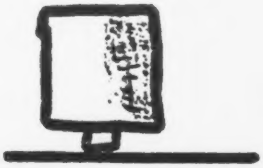
Grade 4











CUTTINGS

Sandy Kinder

I agree that the remedy for the improvement of American schools is not "doing more of what we are presently doing--more hours, more days, more homework, and more standards".

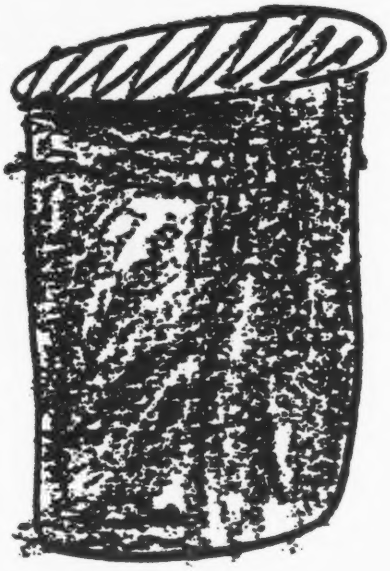
First we need to make the improvements--why do more of a mediocre thing? I also agree that American school children are bored and so are many of their teachers--like me for one. This class has been a real shot-in-the-arm for me--I'm really excited about all I'm learning about children's thinking and learning processes. I've been one of those teachers who was concerned with arithmetic computation, stressing speed and accuracy. I thought I would just scream if I said "Let's get out our books and do pg. 278 (1-50) by tomorrow." My class would moan and groan and I'd sit down and hope someone would not understand so I'd have someone to communicate with--every time I tried the activities and class tryouts I saw a GLEAM in many students' eyes and their teacher's (me) also. I realize I've just scratched the surface and I've got a lot of work to do--but I've started!

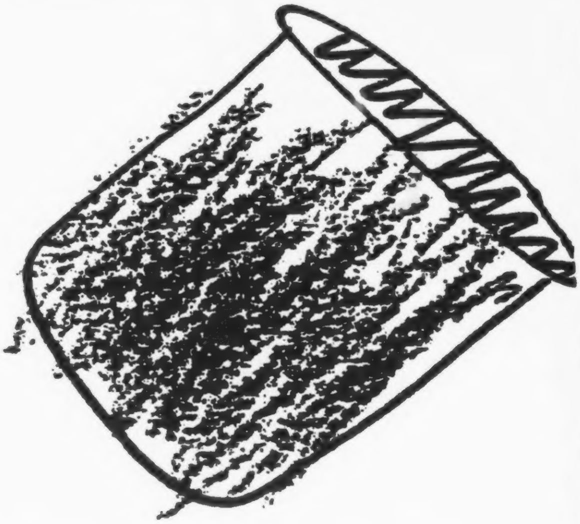
Well you were right about the attribute blocks--they are addicting! My 11-year-old daughter is hooked. Everyone who has come over to see her has been taught some of the attribute activities. We went to the Lake of the Ozarks over Memorial Weekend and it rained and rained and rained some more. We were shut up in a cabin with 8 people and those attribute blocks. We also had the game of "Trivia" which I have concluded is just a bunch of "static facts" that I missed somewhere down the line.

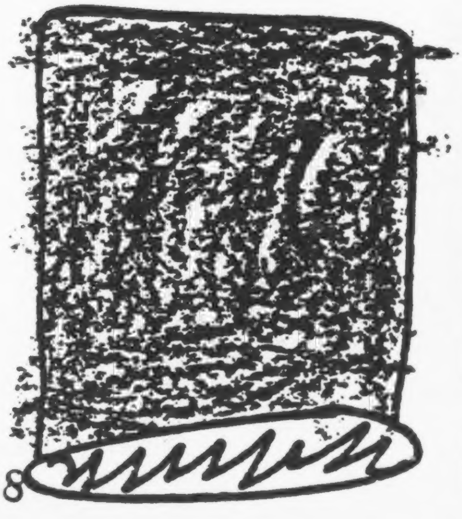
Back to the attribute blocks--my daughter has been carrying a paper sack of them. She'll walk by and either hide one in her pocket and say "I bet you can't guess which one's in my pocket" or she'll hand me the bag and say "Hide one and I'll guess it in--Oh--6 guesses--I bet I can." Now I will tell you her theory. The least amount of guesses to figure out which one is gone is 4 and that only will happen when your first 3 pull-outs (from bag) are no's. She did this only once actually when the hidden piece was a small, thin, yellow, hexagon. The first one out of the bag was a thick, big, circle, blue. The second pullout was a thick, blue, big, square, and the third pullout was at the point where she knew the (yellow) color, the small size, and the (thin) thickness. Now she needed to figure the shape which could be either rectangle or hexagon. She then pulled out a thick, red, big, hexagon which was a yes. And then she knew the shape.

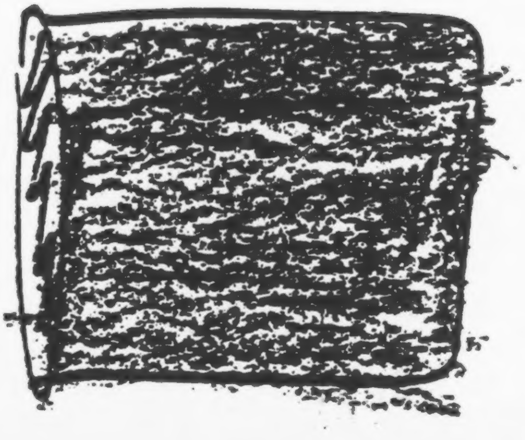
As I wrote this up last night I thought of some questions to ask her this morning. The first one was: Given the situation with the small, yellow, thin, rectangle hidden, what blocks could have been pulled out to figure the hidden block in less than 4 guesses? She came up with a new theory that the hidden block could be guessed in 3 guesses if the pullout pieces are 2 no's and 1 yes. I asked her if it could be guessed in 1 or 2 pullouts and she said, "No" because there are too many shapes. The first "no" pullout tells you size and thinness or thickness and eliminates one color and one shape. The second "no" pullout eliminates another shape and color. But if there's a third yes that has the same attribute of shape only, then you can guess the hidden piece in 3 guesses. It would not be possible in one or two guesses.

Grade 1









DO YOU KNOW WHAT YOUR CHILDREN ARE THINKING?

Lois J. Trampe

Being new at child watching, I thought that having had this group of children for seven months, I knew a lot about them and what they knew. Was I ever surprised!

I tried the HIDDEN COUNTER TASK on several children, ages four years to six years, and most of them responded much as I thought they would, guessing at the number of chips hidden under my hand.

The child that awoke me to realizing that I wasn't as knowledgeable as I thought, was six-year-old Andy P. I started with 8 counters and covered 4. Andy guessed 4. When asked how he knew, he said, "4 and 4 are 8."

Then I covered 5 and he guessed "3." I asked him how he knew and he replied, "You see 3, and 3 and 1 are 4, so you have one more under your hand which makes 5, you have 5 hidden."

By now I was amazed, I had no idea he could do such complex thinking.

I then hid 3, and he proceeded to count "5, 6, 7, 8. You have 3 hidden."

Getting more excited, I tried one more time. This time I covered 7, and he said, "You have 7 because 8 take away 1 is 7."

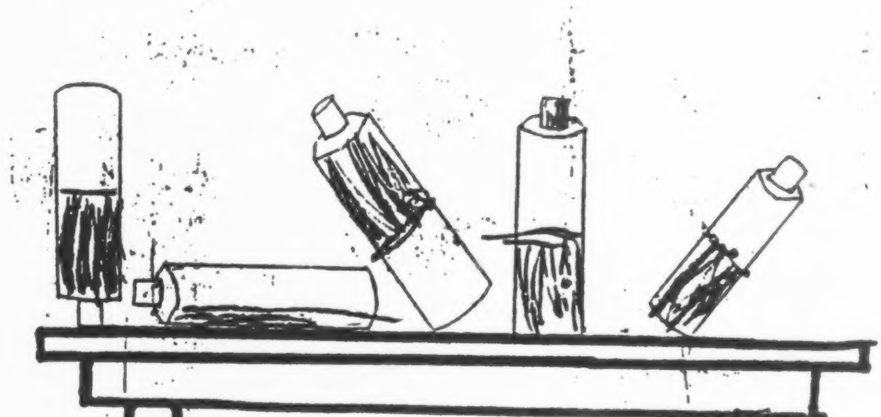
Needless to say, I was excited and a little embarrassed that I had not picked up on this child's ability to use math as he could. Here I was asking him to count the balloons and circle the number that showed how many there were.

Several days later I was recounting my find to the boy's parents. They were pleased but also amazed at his capacity for numbers. His father related the following account to me.

The family had gone to visit Andy's grandfather who lived on a farm. His father and grandfather were discussing the replacing of 17 fence posts and the grandfather said he thought he could replace 3 posts a day and finish the job in 5 days. Andy tugged on his father's sleeve and said, "Dad, Grandpa can't do it in 5 days because he would have 2 posts left to do."

How many other children have passed through my kindergarten class without my finding out what they knew? Do I dare continue to cover the mathematics text or do I stop talking and start listening? If I am wise, then I will do the latter and begin to provide opportunities for the children to construct their knowledge.

Grade K - Age 5



PARKING LOT COMPUTATIONS

Robert H. Bresnahan

My special education class in mathematics has altogether experienced eight years of formal class time. Moreover, during those eight years they have been exposed to a fairly similar curriculum which emphasized problems in addition, subtraction, multiplication, and division. During that time they seem to have retained only a passing acquaintance with many of the operations since they always seem to have to start over. Their process of learning, of course, has been to do multiple problems in each area of mathematics--and to do this over, every year.

The operations, of course, are vital. The way the operations have been "taught" is criminal. To get away from the textbook and possibly to make math more meaningful, we tried something new.

We decided to survey the parking lot at the high school and apply those results to other mathematical operations. The survey consisted of a number of questions which the students created. They wanted to find out what were the most popular types of things represented and which of the unique items they could record. They intend to tally this information and then publish it in a newspaper article.

Some of the questions they were interested in answering were:

1. What is the most popular car owned by students?
2. What was the newest car? the oldest car? the average age of all of the cars?
3. What was the most popular color? the least popular?

4. What type of tire (brand name) was favored?

5. What were the most popular "add-ons"?

6. What types of interior were most favored?

This initial survey was then taken to other parking areas throughout the community to see if the results were consistent or comparable. The students then added a new twist to the survey. They decided to do a follow-up study.

The follow-up survey came six months after the original and featured the same questions. However, the students added a new dimension to the survey with some "people" questions.

1. Which students drive to school? What grade are they in?
2. Who owns the car?
3. Do kids who take certain courses all have cars; e.g., auto mechanics, auto body, etc.?
4. Why did these kids take the course in the first place?

Other aspects of car relationships were also pursued.

1. How many cars had had work done on them over the past six months?
2. What type of work?
3. How much was spent on the car?
4. What were the major problems?
5. How much time is spent on working on the car?
6. How often do they wash and wax the car?

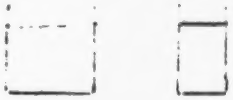
The students tallied this information and when they had completed the results they submitted them for publication in the school newspaper. They utilized all of the typical mathematical skills they would have used if they had spent hours on doing problems, but they had a much more enjoyable experience doing those operations this way.

DOES AGE TELL US WHAT A CHILD KNOWS?

Lois Trampe

The task was to see if a child could fill a jar with the same amount of water as the jar the teacher had filled. Both jars were of equal height, but one jar was smaller around and narrower at the bottom than the other jar.

I filled one jar, the one that was larger around, about three-fourths full.



Jane, who was 6 years old and 2 months, tried the task and filled her jar to the same level as my jar.

TEACHER: Class, did Jane give herself the same amount of water?

CLASS: Yes

ANDY S.: No, she's not right. [Andy is 5 years 10 months]

TEACHER: Why do you think it is not the same?

ANDY S.: Because her jar is different, it's not the same, the bottom is smaller , and it is not as big around.

Jane gets down on her knees so she can look at the level of the water, then shakes her head.

TEACHER: What do you think Jane?

JANE: I think they are the same. I have the same as you.

TEACHER: Class, what do you think? We have two different answers. [Some began to laugh at Andy and agreed with Jane. I was worried that Andy would weaken and change his mind since he was a sensitive child and embarrassed easily.]

ANDY: [A little red in the face, but with a determined look on his face] You're wrong, I know it's not the same. [One or two begin to agree.]

TEACHER: What would you do so that you would have the same as mine?

ANDY: Add more water. [Which he did.]

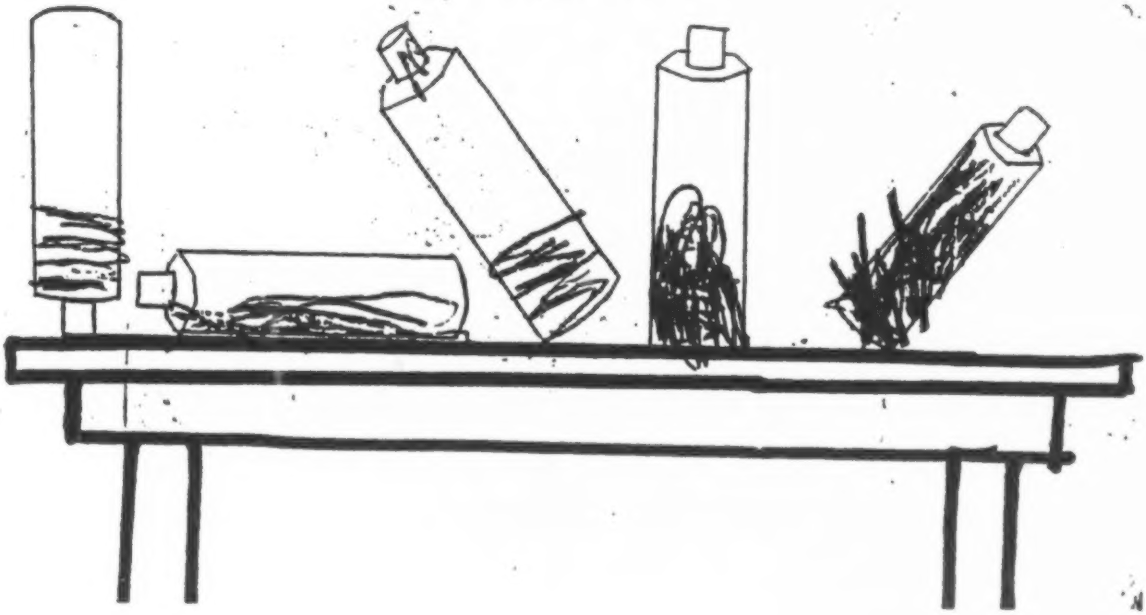
TEACHER: How can we find out if both jars have the same amount of water?

CLASS: Measure the water.

We proceeded to measure the water and saw that Andy was right and he added almost the exact amount of water.

I could tell that Jane was not sure why you needed to add more water, as were many others in the class. This is another reason to stress the need for teachers to get in touch with your class. Age isn't always the best measure of a child's knowledge.

Grade K - Age 4



SCIENCE EXPLORATIONS

Nancy Sweet

I do this activity after a lesson on living things in Science. Divide the class into groups--four students/group is the best size. Provide each group with four pegs, string, a yardstick or meter stick, and magnifying glasses. They also need a notebook and pencil. Take the class outside to a grassy area. Each group should measure a yard square, insert the pegs, and tie off the square with the string.

The groups should then begin studying the square with their magnifying glasses. They should look for plants and animals.

I ask the children to record how many different plants they find. We group these as best as we can--grasses, weeds, flowers, etc. They also record how many different animals they find and classify usually by counting identifying features. How many legs? Are there feelers? How many wings? Etc.

After we return to our classroom, the groups then compare their discoveries. We discuss how the lists of the groups are alike and different. We also discuss whether we would find the same thing if we went back to the same square the next day. If so, what would be there and if not, what would be gone and why? The children decide the plants would be there but probably not the animals.

The children also are encouraged to see what they can discover in the square in their own yards and how that compares to our square at school. Finally, we expand to speculate on a square in some "far out" places like the North Pole or the desert.

LET THEM THINK

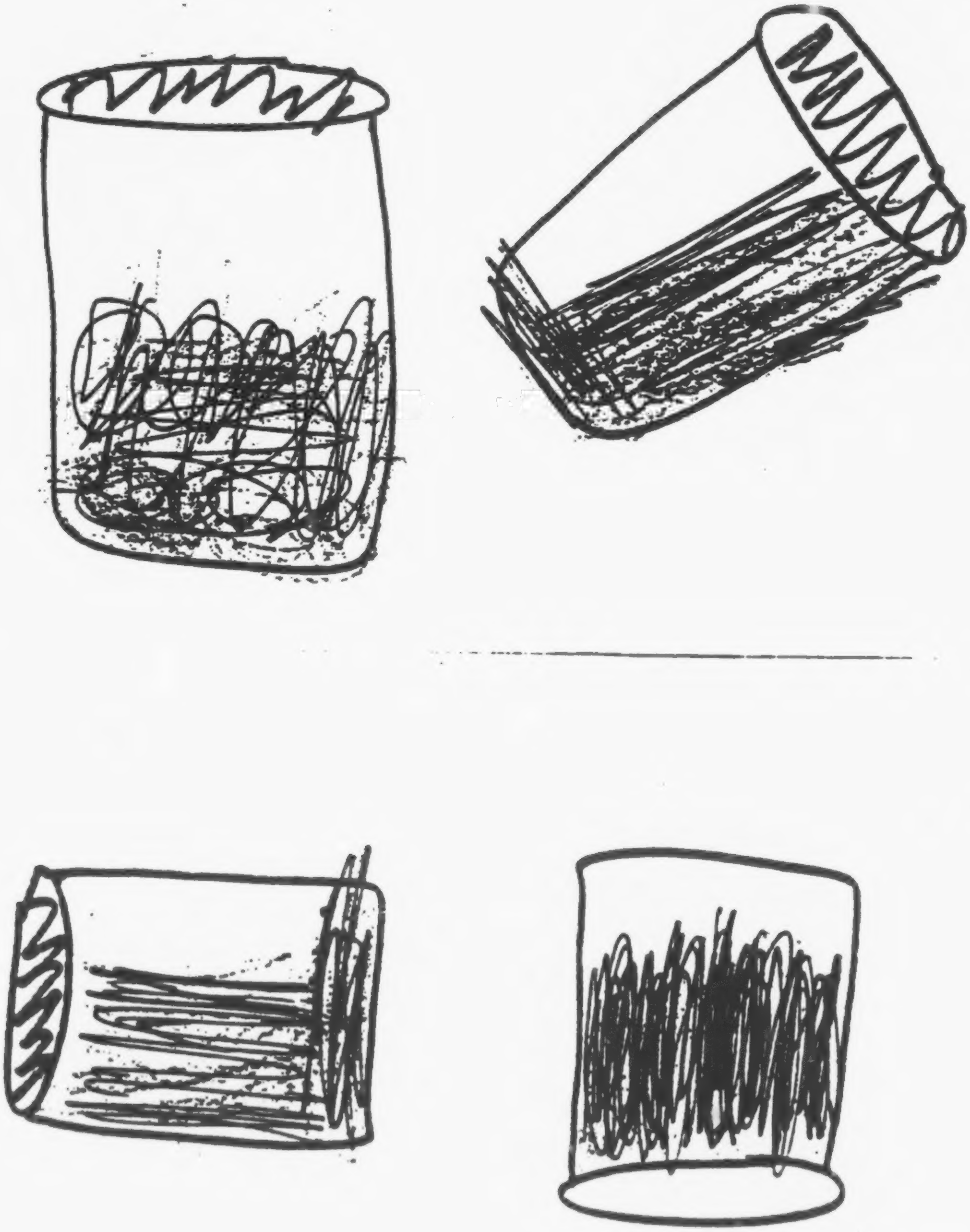
Karen Riess

My oldest daughter (now a healthy five-year-old) weighed 1 lb. 12 oz. at her 2 1/2-month-premature birth. Besides the basic life-and-death questions, I was very concerned about possible brain damage and resulting mental capacity. During her ten-week stay at Cardinal Glennon, I spent many hours just talking with her nurses. One night I asked a nurse if my daughter would be able to "think." It was very late, I was tired, and my choice of wording was less than professional, but the response I received is one I think of often.

"If you mean 'think' in the sense of problemsolving, of course she will. Just remember that no two individuals, whether they are preemies, full-termers, or even adults, think completely alike or at the same level. When your Andrea wants attention, she scoots that little rear to the edge of the water mattress and kicks on the incubator until someone comes. Now that's problemsolving. That little boy over there doesn't have the muscle control to move very well, so he just screams bloody murder. Now that's problemsolving. You just asked me what you could expect from your daughter. You are also trying to confront problems and begin to solve them. No one can predict your daughter's full mental capacity. Whatever that capacity is, make sure you let her use it. Don't stifle her ideas no matter how trivial they may seem. Don't solve all her problems for her. She'll do better at that than you can ever imagine. Enjoy her now and quit worrying about tomorrow. She's alive and can think and love. Now go home and get some sleep."

Even though I'm ashamed to say that I can't remember the nurse's name, she did more to change my ideas about all children than anyone else in my life.

Grade 1



PARABOLA BALL

Karen Riess

Toward the end of the school year, motivation of eighth-grade students becomes increasingly difficult. In a discussion of the graphs of quadratic equations, I asked students what sorts of things were shaped like parabolas. Answers varied from the St. Louis Arch, to flowerpots in my room, to the arc of a softball. Seeing my chance for some added incentive, I told the class that if they could come up with an equation that would approximate this arc, we would go outside and "study parabolas" (play softball).

The class decided the distance from the pitcher's mound to home base was to be 40 feet and the height of the arch was to be 10 feet. (I had not originally intended to be this specific, but thought I would see how well they could do within their set parameters.) We started out by plotting points to review the graph of the equation y = x^2. We then discussed what kinds of variations this equation could have. (The idea of changing the coefficient on the x term and adding a constant came easily since we had already studied the general linear equation y = mx + b.) The class then got into small groups to test their ideas.

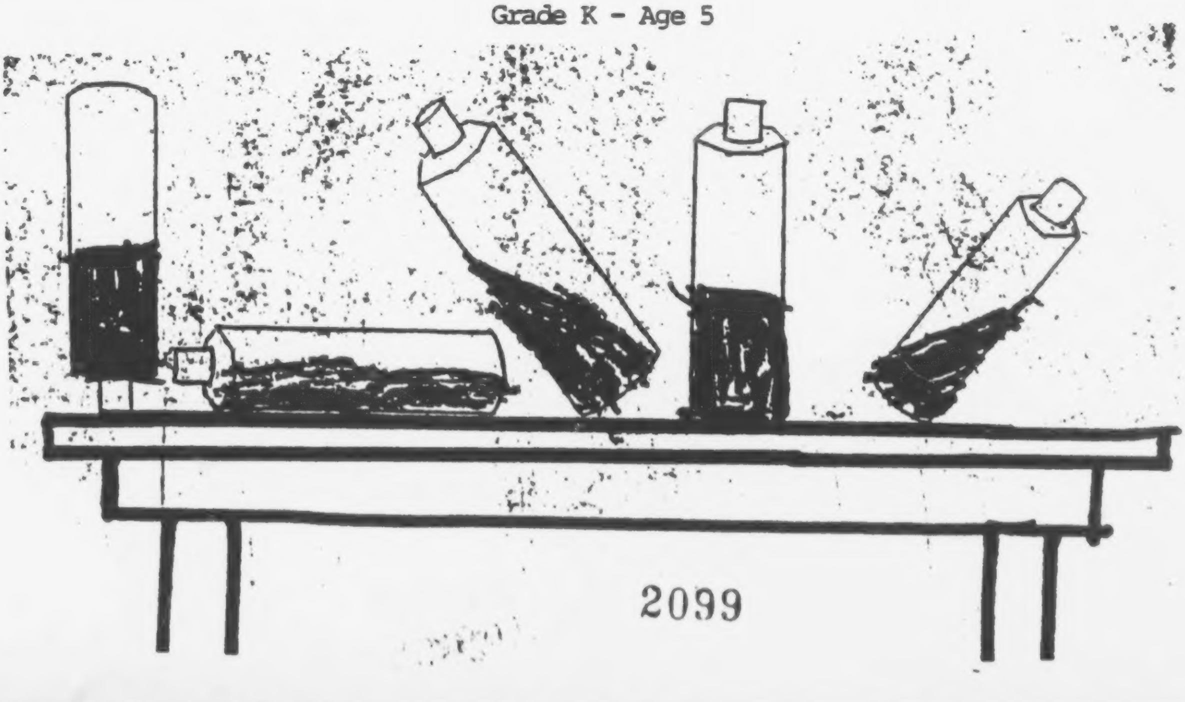
Most students realized they had to turn the parabola upside down, move it up (they considered the x axis to be ground level) and flatten it out so the ball wouldn't have too much arc. The problem most of them had was in trying to do this all at once. After several attempts, most groups realized that if they changed only one aspect of the equation at a time, they could more easily tell exactly what was happening to the graph.

Excited discoveries resounded from all corners of the room. ""Hey guys, positive constants move it up." "Yeah, and negative constants move it down. " "Look at this. A negative coefficient will turn it upside down. Now we're getting somewhere." "Did anybody get theirs to flatten out?"

It was interesting to note how many students "forgot"" that fractions and decimals even exist. They used positive and negative integers, but were almost to the point of giving up and saying there was "no way" to flatten the curve "without changing the exponent or somethin' else weird like that." I intervened and asked if they were thinking of all of the possible types of numbers and turned them loose again.

It wasn't long before the class agreed upon the equation $y = -1/40 \; x \; 2 + 10$. They seemed perfectly content with their equation until someone commented from the back of the room, "But we don't pitch from ground level." Back to the drawing board!

Grade K - Age 5



CUTTINGS

Lois J. Trampe

Playing a game with a small pair of dice, we were interrupted by my 18-month-old nephew who kept grabbing the dice. So his mother gave him another pair, which happened to be larger. It was interesting to watch his facial expressions. First he would look at his dice, then the ones we were playing with. This went on for a few minutes, till he decided to place his next to ours. Either by the feel of the dice, or by looking, he realized that they were not the same. Being unable to talk, he could only jabber and by his expression, we could see that he knew they were not the same. In Piaget's words, disequilibrium happened. He threw his dice down and grabbed for ours again.

READINGS

THE PIAGET PRIMER , Chapters 6,7,8

CHAPTER 6 :

Piaget discusses the role of language in thinking, learning, and teaching. As a child develops in language skills, he is actively constructing his language by imitation of adults--not parroting--and by application of rules. His dissatisfaction with the plural form of "foot" is an example. Often his sentences are reduced to only necessary information which indicates he is creating rules that relate to adult sentence structures.

At the beginning of the preoperational stage, the child has the ability to detach thought from physical action. He now can represent objects, actions, and events for himself through mental images and words.

Language is the most complex and abstract mode of representation. Piaget has identified three levels of representation with two levels being preverbal. They are: Index , where part of the actual object represents the whole; Symbol , some resemblance to real objects, yet distinct from real ones; and Sign , a kind of symbol with no resemblance to a real object.

Logical thinking precedes language and often unduly the acquisition of language. For instance, preconservers tend to focus on one variable at a time in describing differences, so they are unable to apply the terms longer, bigger, etc., thus influencing their language usage.

Logic gives meaning to words. At age 7, some children may understand "more" in terms of amount, but not in terms of area, weight, and volume. They may have appropriate vocabulary, but it may be limited to specific application.

Language neither develops logical thinking nor solely explains

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thought; nevertheless, it remains a necessary condition for its development. Language extends logical thinking to its highest levels.

It is known that telling is not always the same as teaching. The teller and the listener needs to have the same framework to make communication. We hear what we are prepared to hear, therefore; concepts cannot be transmitted through language alone. A rich variety of experiences and ideas might help a child make some connections through the teachers' language, but in the end the child must make his own connections.

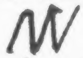
COMMENTS

After reading this section, I shudder to think how many times I have used words to describe a new concept, and then foolishly thought that because children could say the word or use it, they understood it. I need to keep in mind that for children to grow in language and logical thinking they need opportunities to construct their thinking, and I need to provide as many as possible. In giving directions I need to use terms they understand, examples they grasp, and keep in mind that the more I get in contact with children's thinking, the more communication will take place.

CHAPTER 7 :

This chapter deals with constructing more elaborate concepts of length. Most children at age 6 and 7 will view numbers and length as independent encounters with the environment.

COMMENTS

I discovered that this was true. One child counted the sticks and said his road and mine were the same. One girl thought mine was longer because it had curves. 

When my sticks and hers were placed side by side, she noticed mine were shorter. I'm not sure I conducted the experience correctly or helped the children grow. I'll keep trying.

Conflict brings disequilibrium which in turn energizes new learning and finally produces a stable structure at a higher level of equilibrium. As teachers we must be careful not to threaten a child by only questioning when an answer is wrong. Sometimes an indirect method of questioning will pose an interesting challenge and cause the child to justify his response.

When a child shows resistance, it could be that he cannot put new information in an existing framework. Sometimes it's best to wait awhile, then approach the task again with changes in presentation, maybe reducing the amount of information the child has to consider.

Piaget's view indicated that higher-order learning can only take place after some frustration has been experienced.

COMMENTS

It is my responsibility to recognize when children have conflict and provide ample time to solve it.

The implication is that educators should acquaint themselves with children and how they think and provide materials and activities that most likely incite children to integrate their natural strategies towards higher learning constructions.

Piaget developed a sequence that presented the most difficult first, while the last one is the least difficult. He feels this encourages a child's active construction of more elaborate concepts through coordination and integration.

Finally there is a need to help the child transfer his learning by presenting tasks that are similar but use different materials. The teacher should then question the child's responses and give counter arguments.

To check the stability of a child's learning, another assessment should be given within seven weeks.

CHAPTER 8 :

Piaget's position in developmental psychology is in direct opposition to the behaviorist position. Both have their roots in biology. A stimulus produces a predictable response in animals, but Piaget observed that humans were less predictable. Piaget focused on the intermediary processes between stimulus and response, while behaviorists focused only on the stimulus and response.

Behaviorists feel that treatment and quantification are standard, but Piaget feels making contact with the child's thinking is standard.

Behaviorists don't recognize stages of development but say the individual has a lack of experience. Piaget believes that learning takes place with a series of progressive intellectual reorganizations.

Neither theory is complete nor totally correct. Both have their place. The behaviorist theory has potential for lower-level learning, and Piaget's theory has power to explain higher-level learning. Programmed instruction has its place but so do exploring, learning, and thinking.

COMMENTS

I can see that today schools seem to try to accelerate children to higher-level thinking instead of providing varied exploration activities so the child can construct his own thinking. It's "Hurry, hurry," cover this much material by the end of the year. Who cares if they understand it?

It is my duty to get a feel of where my class is and what level of thinking they are on, then to present new concepts using activities that lead the children to construct their learning. Getting an idea as to where each child's level of learning is, will not be easy for me, but with more experience in child watching, maybe I can do it. Less telling and more task activities will be my goal.

TRYOUT

Another large-group activity I tried was to use colored water and several containers that were obviously different sizes, but I also had 2 that were very close in height and width. One had a narrower bottom. Of course no one had trouble picking which held the most from the more obvious containers. Then I used the containers that looked the same, and all guessed that they would hold the same. When I transferred the water and one container didn't hold as much, the puzzlement was very evident on their faces. In answer to my question as to why the one container did not hold as much, one child suggested that it must be taller, we measured again, and no it wasn't. Finally, Andy (my very observant child) said, "I think they must not be as big around." Then we compared and some saw that the bottom of the one was smaller.

Being able to conserve height and volume at the same time is apparently a difficult task for some to do at ages 5 and 6.

READINGS

THE PIAGET PRIMER , Chapters 9,10

CHAPTER 9 :

"Teaching towards a congruence with children's natural capacities and constraints."

As a teacher, it is necessary to observe children's thinking levels so as not to introduce concepts that they are not ready for. The role of a teacher is that of observer-planner not planner-instructor.

The limitations of textbooks fall into three problem areas: inappropriate content level, lack of manipulative provisions, and an over-reliance on pictorial and abstract exercises.

COMMENTS

The teaching of reading to children younger than 7 invites problems, as a child's ability to make fine discriminations when comparing words and their components is still being developed. (Yet the pressure to teach reading to younger and younger children is there. I've even heard of some who think that it should start at ages 3 and 4. Horrors!

Formal teaching of math and reading should be postponed until a child's perceptual and logical thought processes are developed enough to support it. In place of formal teaching, Piaget suggests that spontaneous play be used to develop the child's capacities for representation. Several things were mentioned: block-building, sand play, cooperative games, observing and describing change, all of which the child can transfer to reading and language experiences.

Children need a great deal of experience with materials before abstractions become meaningful. The time spent is not wasted for much is gained.

COMMENTS

(As I stated before, not enough time is spent in allowing children to build relationships to numbers. They are moved too quickly to abstract representations. They lose their confidence and actually lose ground.)

Most subjects taught in school today are language-oriented which limits the teachers' view of children's level of understanding and capacity for learning. More activity is needed before abstract ideas are used.

COMMENTS

Time spent getting in touch with the child's level of thinking would be time well spent. Not only would you be able to help the child develop but you would save a lot of time not "teaching" material above or below their ability.

In the section on introducing lessons with labels and definition, the approach suggested helped me in giving directions for a readiness test. Instead of using the suggestion in the manual of telling the class what the word meant, I drew the meaning out of them and ended up with many other similar words. The word was "group," and we got into schools of fish, flocks of birds, herds of elephants, etc.

CHAPTER 10 :

"DEVELOPING A CLASSROOM ENVIRONMENT FOR ACTIVE LEARNING"

In a classroom the teacher's role is to be a facilitator of interaction. A child needs to handle objects in order to develop logical thinking. This can be done by providing specific activities for the children, gathering material that is thought-provoking, and managing the material to continue the child's thinking to its highest level. In conducting a group experience, a child learns to interact with others and to work cooperatively while conflicts and room rules can be set by the group. Natural learning requires more time than schools are prepared to give.

The way a teacher responds to a wrong answer sets the stage for success or self-alienation and a kind of trained helplessness.

COMMENTS

(I visited a kindergarten 2 years ago which had been recommended to me because the teacher was so good. I was so uncomfortable that I couldn't wait to get out of there. The children were like robots, responding when asked, hardly a noise was made, no one moved unless asked to. "Perfect discipline." The teacher could move from one thing to the next without any interruptions, but I wonder how much real learning was going on. No one raised a hand to talk except to answer the teacher's questions. By the way, she spoke almost in a monotone voice. There were two sessions and both were identical, as if recorded. I have never been able to present the same lesson to another class in the same way, but she did. I need order but not silence, activity but not choas, and I need feedback not regurgitated stock answers.)

A child needs to make mistakes if he is to grow. A teacher's role is to gain insight into the child's level of understanding and then to provide encounters that will become springboards to the construction of a higher level of equilibrium. This learning cycle has 3 phases: exploration, invention, and application. All responses are listened to because a teacher can strengthen the child's thinking process. A non-threatening teacher can set the tone of a classroom where a child is allowed to flourish without fear in an accepting, supportive environment.

MATHEMATICS TEACHING , No. 58, Spring 1972

"Teaching Children Thinking" by Seymour Papert

Mr. Papert describes how computers can be something the child himself will learn to manipulate, to extend, and to apply to projects, thereby gaining a greater and more articulate mastery of the world. He agrees with Dewey, Montessori, and Piaget that children learn by doing and thinking about what they do.

Children with a suitable clear and intelligible programming language can invent and carry out exciting projects when given access to computers.

Instead of teaching a child to learn, think, and play, we try to stuff numbers, grammar, and the French Revolution in their heads. Some say teaching a child to learn, think, and play could impede their learning since we know very little about cognitive psychology. The paradox is that they are making up theories about everything, so the real choice we have is either to give children the best ideas we can about cognitive processes or to leave them at the mercy of theories they invent.

In the culture at large, a set of popular ideas about education and the mind has developed which Papert calls "Pop-Ed Culture." Some examples are: "Blank-Mind Theories": Make your mind a blank and wait for an idea to come. "Getting-it": The child expects understanding of math to come in a flash, you either get it or don't get it. "faculty theories": An elaborate classification of mental abilities, "he's a brain," "he's dumb." To combat these theories, Papert suggests creating an environment in which the child becomes highly involved in experiences. Within a short period of time, enough programming language can be taught so that he can use the computer. In one experiment, seventh-grade children were writing programs to play games within 3 months. Most children became motivated to work on projects that extended over several days or weeks. Quite a contrast with the style of work in most mathematics classes where children worked on problems more rigidly defined by the teacher for a shorter time.

COMMENTS

(I have seen evidence of the "Pop-Ed Culture." This has come into existence because of the way we teach children.)

Our school has just installed 3 computers. I hope they will be used to stimulate thinking, instead of as just another gadget to teach the same old stuff. Of course this brings us back to the same linked problems: the time needed to give children the experiences and the traditional time structure; limited use of computers and the size of class; how do you "grade" thinking and the pressure to teach something that can be regurgitated.

OBSERVATIONS, COMMENTS

Examples of egocentrism: Three girls were playing house and saw the wagon sitting across the room. They decided to use it, but some other children, closer to the wagon, started to use it. Tears followed because they "saw" it first.

During Show and Tell when I ask if they want to know anything else about the object being shown, they proceed to tell me about something of their own.

Two girls coloring at their desk and beside it a toy they were not playing with. A boy picked the toy up and the girls compained because they had seen it first, therefore it was theirs if they wanted it.

READINGS

SEEDBED by Helen L. Miller, Number 14, Jan. 1983

Two years ago, I had the opportunity to experience Helen (the only way I know how to describe her) as a presentor of "Teaching Math to the Young Child" at Missouri's Early Childhood Conference. I thought then "what an individual, if only I could acquire some of what she knew and some of her energy." After reading this issue of Seedbed, I can understand that where she is in her knowledge of children comes from hours, days, and years of child watching, plus lots of reading. I have begun and plan to continue. She has been an inspiration.

Helen's articles on children's thinking and understanding of language pointed out that using preprinted material has its drawbacks. A child identifies and labels items according to his own personal point of reference. If a picture is identified by the teacher as meat, but the child identifies it as "roast," then it should not be on the page dealing with the sound of "m."

I have observed this many times and have made it a practice to ask the child what he calls a picture, when it appears he hasn't circled the correct response. Most of the time, it has been the case that he has given it a different name. If this is true, I credit it and don't try to change his response. I do tell him that the picture can also be called .

CHILDREN'S ARITHMETIC--THE LEARNING PROCESS, Herbert Ginsburg

CHAPTER 1 :

In learning to count, children encounter several difficulties. The first problem is saying the numbers in correct order. They cope with this by limiting how many they try to learn. They soon discover that numbers must be memorized up to about 12, after that they discover an underlying pattern.

When children learn to count they often make errors because they lack systematic plans for keeping track of things. It requires more than saying the number words in correct order, they also need to consider things only once. To make a one-to-one correspondence takes years to master. Finally they learn to perceive small numbers of items as a group and apply arithmetic as a shortcut to counting.

COMMENTS

Thinking back to last fall, I can recall how Dover, Liddy, and Carrie counted for me. Dover and Liddy turned 5 in November whereas Carrie turned 6 in September. The two young ones would miscount often because they had no plan of touching the objects. Consequently, they often came up with the wrong amount. Even today, they occasionally make an error in counting, because they haven't quite developed an orderly counting procedure. Carrie on the other hand showed a systematic plan for counting last fall, and now can look at a group of objects up to 5 and 6, and call the amount without counting each one.

The adult's concept of "five" is different than a child's. We know that the order of objects, their physical appearance, and arrangement is irrelevant to their number that is part of a larger system.

A young child's concept of numbers is different from an adult's. The rearrangement of objects changes the number; the physical appearance changes the number; and because each object has a number, the last number does not refer to the set as a whole. Around 6 or 7, children learn to conserve numbers. It's important to remember that the accurate use of words does not guarantee understanding.

COMMENTS

It has been my experience that parents believe that if a child can say the words, he understands the number. I have watched children struggle with counting until they begin to develop strategies for counting, either moving the objects or planning an orderly way of touching the objects. Counting the people in the room still poses a problem for some as they usually miss someone. For snack time, inevitably someone is missed and doesn't get a straw or napkin. I realize now, that this is not an easy task for them, even though the desk are in rows.

I think that counting, rearranging, etc. would be an excellent task to do on home visits to my new kindergarteners next fall.

CHAPTER 2 :

Babies possess intuitions concerning number and observations suggest that infants perceive certain quantitative features of the world. From ages 2 to 6, children's notion of sameness relies on appearances. It is only around age 6 or 7 that they realize that equilvalence has been conceived even if appearance changes. Children at an early age achieve an appreciation of the operations of addition and subtraction. They know that adding to a set makes it have more than it had, but not necessarily more than another set.

CHAPTER 3 :

Much of children's learning involves seeing, doing and understanding, along with memorizing facts. For the most part, adults have little to do with teaching young children informal math.

Children are motivated to learn informal math because it is useful. They need to be able to divide food with their friends, play games, buy things that match the money they have, etc. The evidence tells us that every civilization had a system of mathematics.

Another kind of motivation is called intrinsic, this refers to activities that are done for the fun of it or for their own sakes, without any external reward or practical necessity. For instance, counting over and over, working worksheets, or playing games.

COMMENTS

I have experienced both of these motivations. Carla and Carrie are examples of intrinsic, as they like to have any extra worksheets I have so they can do them. Observing children over the years, it seems they are always counting. They count everything from their crayons to the tiles on the floor.

Children's learning is largely a self-directed process. When they become interested in a problem, they practice it, attempt a more difficult problem, and ask for help only when needed.

The role of parents, T.V., books, etc., is to provide help and information when a child needs it. Piaget uses the terms "assimilation" and "accommodation" to describe this process. The child assimilates into his own understanding what culture has to offer and then accommodates himself to the cultural wisdom: like learning the counting numbers in correct order.

COMMENTS

When a child is working on a problem, it is my experience that if you try to help too soon, or before you are asked, the child will walk away from it or at least give up. An adult trying to help often suggests showcuts, which only confuse the child as he can't follow your thinking and it doesn't make sense. Waiting until asked is very important. Let the child pursue his problem with his own intellectual process. Getting help when not wanted takes away the challenge.

Around the ages of 4 or 5, children combine the technology of counting with mathematical ideas; the results are practical arithmetic. This involves 2 steps: the interpretation of problems and the implementation of a solution. What seems to be a simple problem to adults involves several intellectual processes. As children develop greater proficiency in dealing with imaginary objects, they may count up from the largest number or finger count when putting numbers together. Eventually internalized counting happens.

Written sybolism is not easy for young children. It presents extra work and comprehending the events taking place is difficult.

Around the ages of 5 to 7, children become more adept at using tallies, yet the symbols were more useful than the numerals.

Children are more comfortable with practical arithmetic than with school arithmetic. This is because practical arithmetic is relevant to the child's environment.

COMMENTS

How true this is. No matter how hard textbooks try to give relevant examples, it is usually the case that the child sees no relationship to his experiences. If Jimmy has 3 cookies and gives Ellen 2, who cares, because if I had 3 cookies, I'd eat them, or maybe give only one away.

To help a child learn the elements of arithmetic, keep a proper balance between teaching and fostering of spontaneous growth; get to know the child's intellectual life; provide a stimulating environment; trust and support the child's intellectual work without pushing, training, or drilling; give special support to the child's counting, show them how to move things aside.

Things to avoid: don't try to teach new math; avoid formal training, especially verbal instruction, and try to foster a child's attempts;

skip the readiness activities, they are already interested; don't waste time on the training of conservation, they will learn it in due time; and keep in mind preschool children's tremendous accomplishments, don't focus just on their weaknesses.

COMMENTS

To try and keep a balance between teaching and fostering growth I introduced the lesson on 8 by asking someone to count the glue bottles that had purple lids. When Carissa had counted them, I asked her to tell the class how many, she said "8." I noticed right away the girl setting close to the glue bottles was counting them, so I asked her if Carissa was right. She agreed. Then I asked if anyone could think of anything else that was 8.

We had been reading Backyard Zoo and right away several said, "Spiders." I got the book and had someone to check it out. Gus said a Daddy Longlegs had 8 legs, so we checked that out. By now everyone was busy thinking, and several insects were named; but after checking, we found they only had 6 legs. Erin, rather sharp with numbers, said, "they need 2 more legs to have 8."

Then I asked how they could show 8 with their fingers. Some put up 4 on each hand, a few showed 5 and 3. I gave 3 children the beads and asked if they could show 8. They all counted out 5 then 3. When asked if they noticed anything they saw that there was 5 of one color, 3 of another.

To me the amazing thing was that they presented a much richer lesson than I could have and they brought a vast amount of knowledge to the classroom.

Upon doing the page in their book, I noticed that one or two put little marks on each thing in a group to count it. This seems to be rare at this age, somehow they knew to mark off each thing as they counted so as not to repeat. Once in a while on numbers above 5, I have observed that the pictures on pages are hard to count because they can't move them, so they repeat some. One more reason to use real life objects, not one-dimensional pictures.

CHAPTERS 5-9 :

"Computing with Written Numbers"

With children, understanding informal math precedes their ability to write it. When asked to write numbers at a young age, they might write exactly what they say: 203 for twenty-three. Understanding of the place value system to write numbers comes after years of schooling. Not all children reach the understanding of the theory of place value.

COMMENTS

After doing the activity showing place values in class last week, I can understand why some children never reach a clear understanding of place value. So often we teach the theory using only a few objects and switch to marks on a board for the larger numbers. The relationships and value of the numbers is never clear. Here is another reason to give "hands-on'learning" into the grades, not just in preschool.

To compute, children become very inventive. Counting methods to do addition, subtraction, and multiplication still seem to be the most natural way. Unfortunately, many teachers frown on finger counting. Some children combine counting methods using remembered facts and algorithms or convert the task to a more manageable one using facts they know and remember.

"Mistakes"

Children's mistakes are often based on rules, but faulty rules. They might add correctly but write down the wrong number and carry the wrong number. Misaligning numbers is another common area for error. Most of these mistakes come about because the textbooks and instructions explain mathematical principles badly and little attention is given to children's questions.

Some children see math as an arbitrary game. You can use any method you want, since there can be no mistakes. One boy felt that you only got wrong answers when you used the wrong method. Mistakes can occur and exist in a context of competence. One girl showed several ways to add and also could add large numbers showing unexpected competence. Often children display a gap between written work and informal methods and concepts. They see the written math as a game, not related to their existing informal knowledge.

COMMENTS

Over the years, I had the opportunity to "sub" in all grade levels. It is true that textbooks don't always explain math principles in language children can relate to, and if the teacher does come up with a different explanation, the child can become lost. Here would be the time to take the child that is having trouble and try and find out what he already knows and where the problem lies before it magnifies. To prepare my kindergarteners for simple addition, I give them a certain number of blocks, say 8, and then ask them to find out how may ways they can arrange their blocks making more than one pile. As they do this, I write the number of each group on the board. They also have paper to do the same. Maybe we'd get 2 + 4 + 2 or 6 + 2 or 2 + 2 + 2 + 1 + 1. We always checked to see if we still had the same number of blocks. I'm wondering if this is effective or a waste of time?

It also seems that it would be worth a teacher's time to sit individually with a child who consistently made errors and find out what he is thinking. The teacher might find out that the child needs help only with the written work.

"Learning Difficulties"

The cases mentioned once again brought out that many children's informal math is stronger than their written math. School mathematics should be built on the child's intutitions.

The artifical language of mathematics can present some children with considerable difficulties. Simply defining the words does not guarantee comprehension.

All children, even those who fail badly, seem to possess some kind of intellectual strengths which usually involve counting of some form. Using informal methods plays a key role in getting to know and helping children with probvlems. relying on standard tests are of little value and can even be harmful to the child who has trouble learning.

COMMENTS

Watching my son grow more and more apprehensive and frustrated with the taking of tests throughout grade school, led me to agree with Ginsburg, that tests are of little value and do harm to a child who has trouble learning. I remember a fourth grade social studies test he asked me to helphim study for. He went to school confident he could pass it, but when the test came back, he had failed. I assured him he knew the answers, in fact when I read him the questions, rephrasing some that were not clear, he knew almost all the answers. I pleaded with teachers to take his test anxiety into account before he became so discouraged and got nowhere. In the next 8 years, only 3 teachers recognized this and found other ways to check his knowledge of the subject. To this day, those classes and what he was taught have remained a part of his being. I am determined to give other children the same understanding I hoped for.

"Understanding"

When children fail to understand the calculations they perform, it is important to gain insight into their knowledge and help them to connect their calculations with their knowledge. This can be accomplished by beginning with simpler procedures. A child's learning and understanding must originate in contact with specific instances and concrete things. Only then will written math acquire meaning. The recitation of mathematical theory does not produce understanding.

Another aspect of understanding is perceiving the regularities that underlie the behavior of numbers. For instance, that in addition it makes no difference what order the numbers are in. The process of perceptual learning occurs over a long period of time and in several steps.

COMMENTS

Bingo--Here's my problem. I have a difficult time seeing patterns and regularities of numbers. I learned to calculate, but number behavior escapes me. I guess I never related what I knew with formal math. Even today, if you place the same problem in a different setting, I probably wouldn't recognize it. "Math Anxiety!"

"Testing and Teaching"

It is necessary to have a knowledge of children's arithmetic in order to test and teach them. But psychological knowledge doesn't produce lesson plans and curriculum to teach mathematics.

Ginsburg suggests that a teacher should go beyond standard tests to informal interviewing. The child may have more competence than the test shows. Take time to know a child and what he knows and doesn't know. Look for deeper meanings behind children's errors, and upon discovery, you can better help a child. There are many ways to learn; encourage whatever form seems appropriate for children. Help children to make a connection between what they know and what is taught in school. When a child sees that school arithmetic relates to his own understanding, then the child feels comfortable and school math takes on meaning. Relate written symbols to what children already know. Encourage nonstandard means of computation 92 + 18 is 90 + 10 + 8 + 2. Look for a child's unsuspected strengths to reduce the gap between informal and formal knowledge. When a strength is found, build on it. Encourage self-directed learning, it can be effective and enjoyable. Use games, calculators, or whatever you can think of to help children perceive the world of mathematics and how numbers behave.

COMMENTS

That's a big order presented by Ginsburg, but a worthwhile task to attempt. Time can be found if you feel it is necessary. I plan to set aside time each day with a child when we will be able to talk and do things together. The other children will be working on another task developing the skills I have recognized from our time together.

SNACK PACK MATH

Robert H. Bresnahan

While doing a survey on food consumed in the cafeteria, one of the kids noticed that a great many people spent money in vending machines for different snacks. Each snack pack cost thirty-five cents and there was no end to snacks purchased.

It occurred to the student to ask if such a small pack of chips cost thirty-five cents, how much would those chips cost per pound? The chips would cost $7.56 per pound if they were purchased in this manner in the store. Amazing!

This led to all types of investigations by the students on the various vending machines. In each case the per/item costs were astronomical if the price were applied to large quantities of a pound or more at the store. This held true also for the cost of soft drinks. The students concluded that the costs were extravagent until they began examination of the costs of packaging, shipping and stocking the vending machines. The question of convenience was a major point that was brought up by the students. They wondered if the convenience was worth the extra money that the packages cost.

The bulk of the discussion and the different excursions among products provided a real experience in pricing and planning for these students. This was an enjoyable math project that could readily transfer to consumer education or other related courses.

WHAT WOULD YOU SEE IF . . .?

Becky Merrill

Some of the most interesting child-watching tasks are those which are extensions of Piagetian tasks. The following is such a task.

Materials:

Four blocks of different colors and/or shapes

A square table and four chairs

Paper and crayons

Procedures:

1) Place the blocks in the middle of the table in some specific order.

2) Have the child sit at a chair at one side of the table.

3) Have the child draw the blocks as he sees them from where he is sitting; the order of the shapes and/or colors, etc.

4) Now ask the child to draw the blocks as he would see them if he were sitting in the chair to his left. Do not allow the child to move to that chair.

5) Repeat the last step for the chair across from the child, and then for the chair to his left.

(The number of blocks may be increased for older children.)

The results from this task can be very interesting. Be sure to have the child explain his drawings of the blocks when he is finished, then allow him to sit in the four chairs to see how the blocks actually look.

MONEY MATTERS

Becky Merrill

Purpose:

One area of mathematics and problem solving that all children and adults will be forced to deal with at some time in their lives is money math. The following activity not only acquaints students with and gives them practice in using the different coins, it also allows them to think logically and problem solve. The game is set up for two or more players, but it would also work as an individual task.

Materials needed:

Slips of paper with different amounts of money written on them
    ($1.28, $5.39, $ .97, etc.)

A timer of some sort

Pads of paper for solution

Procedure:

Players take turns drawing slips with money amounts on them.

Players are told that they may use any number of pennies, nickels, dimes, quarters, or half dollars.

All players try to make the amount drawn using as many different combinations as possible in a set amount of time. (This depends on the age group.)

The player with the most combinations receives a point for that round.

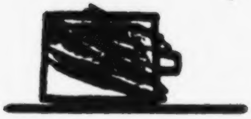
The player with the most points at the end of the game is the winner.

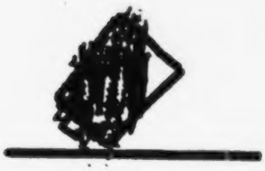
Players may challenge each other if they think a combination may not receive a point for the round.

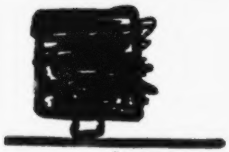
Example:

Suppose the amount drawn was $ .46. Some answers might be: 46 pennies; 41 pennies and 1 nickel; 36 pennies and 2 nickles; 36 pennies and 1 dime; 31 pennies and 3 nickels; 31 pennies, 1 dime and 1 nickel. (There are many other combinations!) Kids love this activity and learn a great deal from it.

Grade 1







FIND ME?

Fern Regensberger

The sum of the numbers in each column, each row, and each diagonal should be 27.

What numbers should be placed where the squares are?

15		
	9	
	17	

The sum of the numbers in each column, each row, and each diagonal should be 18.

What numbers should be placed where the squares are?

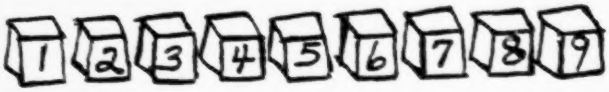
11	6	
		10

Can you make up some yourself?

STACKING THE BOXES

Fern Regensberger

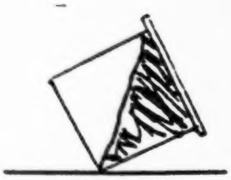
The nine boxes shown below are to be stacked in three equal piles, and the total value of the numbers on the boxes in each pile should be equal.



There is more than one solution. How many can you find?

1.

2.

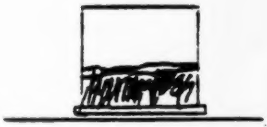


3.

4.

5th Grade

5.



THE WAY YOU LEARN MATH INFLUENCES THE WAY YOU FEEL ABOUT MATH

Kathy Hagen

This statement is not a complimentary one. After participating in my first Teacher's Center Project, I realized what innovative, new, and creative things are being done with children and math. I have been out of the classroom as a teacher for a number of years and things have changed. This is not the way I remember learning math.

My early recollections of math are of time spent on repetition, memorization, and drill, drill, drill. In my early math classes there was only one answer--the one the teacher wanted. The problems were explained quickly and mechanically, then it was on to the drill and practice. Left out were exploration, playing, and manipulation of ideas.

As a result I was unhappy in math. I was a holding tank for facts that were thrown out by the teachers. The most time given to the individual was at test time, to see if the information had sunk in.

I remember so many rules, most of them negative. Never use your fingers to count. Why, they are an always available manipulative tool. Never work with someone, do your own work. Why, discovery can often come from shared experiences. Never leave blank spaces on your timed tests. Why? Perhaps it was more important that I understood how to do the problem than on how fast.

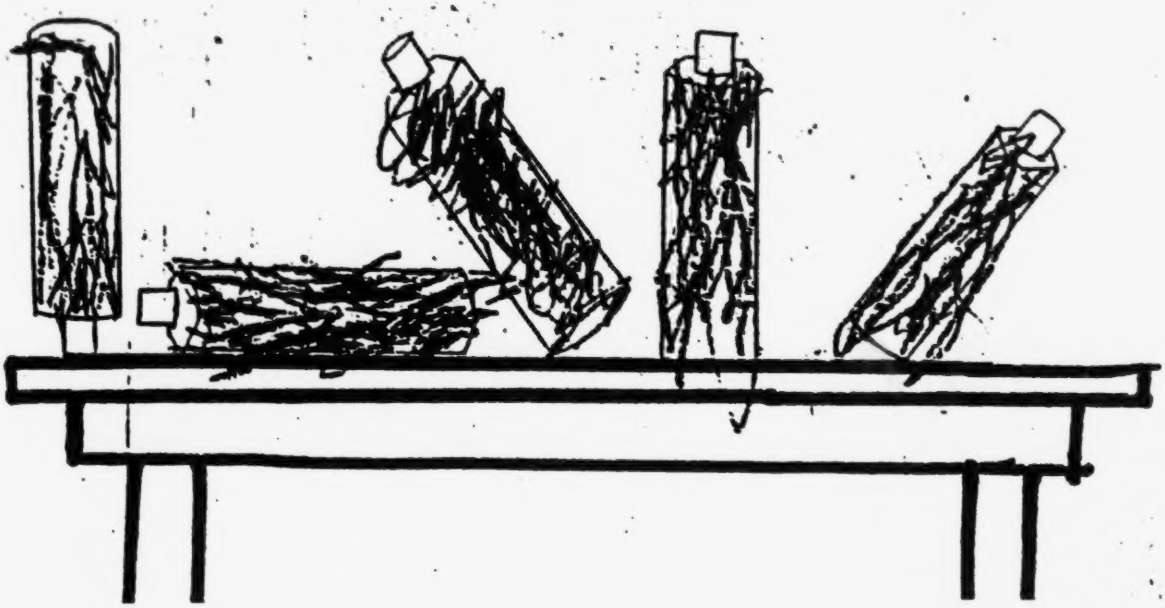
As a result, my success in math was no more than average in grades and even less in attitude.

In 1970, during my third year in college, I was fortunate to have a teacher who changed my whole view of math. And my success as well!

The class dealt with the "bases other than 10" concept, popular at the time. Regardless of the class topic, what she taught me was to explore and play with numbers. She encouraged me to relax with numbers. I could manipulate them, they didn't manipulate me. I was given the confidence to succeed where I had never excelled before.

Although I don't remember her name, this woman became a role model for me. She was the type of teacher the Teacher's Center is all about, what teaching math is all about! Besides judging my success by her teaching, I judge her success by my learning.

Grade K - Age 4



HISTORY COMES TO LIFE IN THE CEMETERY

Sandy Kinder

For the past few years I've had my third-grade students do a unit on the history of our community. We start the unit out by first going to our library and doing research on our city's history. We have guest speakers come in from the historical society, the Chamber of Commerce, Cahokia Mounds State Park, and other local historians. We take walking field trips to different businesses in town to find out as much as we can about how each business started and some of its most eventful happenings. After we have gathered our information, the students decide how they want to present what they have learned. Some classes have made notebooks, murals, slideshows, reports, and filmstrips.

Toward the end of the unit a trip to the cemetery is planned. Before going to the cemetery, I teach or review subtraction with regrouping because I give the students a worksheet to do while in the cemetery that has them figure the ages of the people when they died. If your students have trouble with subtraction, like mine often do, you might try subtraction that is really addition because you actually count from the bottom number to the top. Let's say your problem is 1968 - 1929 = ?. This is how you would have them do it:

$$\begin{array}{r} 1968 \\ -1929 \\ \hline 1 \\ 30 \\ 8 \\ \hline 39 \end{array}$$

First they need to go to the nearest ten from 1929 which would be 30 and it takes 1, then they count from 30 to 60, then they count from 60 to 68, then they total by addition to get their answer. This method may seem confusing at first but once you and then your students understand it, it's easy. It's also pretty useful!

After the subtraction review, we make a time line that includes our community's history and world history. This is what a portion of it might look like:

1868 - Railroad comes to Collinsville
1876 - Telephone invented
1879 - Collinsville Herald began
1880 - Collinsville Cow Bell Company began
1896 - Ford introduces first car
1901 - Smallpox epidemic

After completing the time line, we would go to the cemetery where the history would become real. The children had worksheets which asked them to find people who died before and after 1900, soldiers, infants, family plots, epitaphs, and unmarked graves. They were excited when they found people that they knew were a part of our community's history.

When the students returned from the cemetery trip they were asked to pick one person from the cemetery worksheet and to mark on their time line when this person was born and when they died. Next, I asked them to study their time line to see all the things that happened in the person's lifetime. Then I asked them to write a story about the history of the person they picked, weaving in events happening in our community and in the world that might have affected the person's life. Rich stuff!

TIC TAC TOE TO A FOUR-AND-A-HALF-YEAR OLD

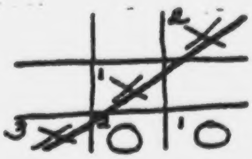
Sandy Kinder

Following are eleven games of Tic Tac Toe that I played with my four-and-a-half year old. I'd never played it with her before but she had played it before because she was able to tell me the rules and play. Also following each game are comments and/or discussion of each game as it happened.

X - Danielle (four-and-a-half years old)

O - me (Sandy)

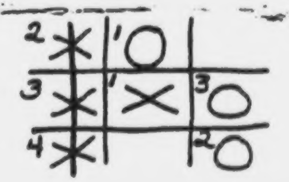
Game 1 X - first



Danielle: Too bad. You should have put it right here!

In class I mentioned that children don't think diagonally until about second or third grade, so after game 1, I thought I had a genius on my hands because she went diagonally to win. Well, by Game 6, my bubble had popped and by Game 9 I knew she was quite normal. She problably went diagonally on Game 1 because there were only four X's and O's on the total board and it was easier to see the diagonal.

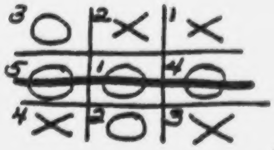
Game 2 X - first



Danielle: That's not the way I was going. (She said this as I put

03 down.)

Game 3 O - first



On 04 I asked: Why did you put it there?

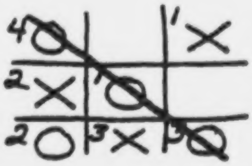
Danielle: Because I wanted to win going down.

Sandy: Didn't you want to block me? (diagonally)

Danielle: No, I wanted to win.

Then when I started to put 04 down she tried to get me to put it on the left.

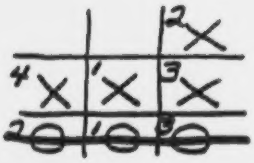
Game 4 O - first



After I put 01 down, she said, "You know where I'm going if you read in my mind."

On X3 she blocked across the bottom and was surprised when I won diagonally on 04.

Game 5 X - first



Sandy: I'm not going to let you beat me across this way (diagonally) this time.

Danielle: I wasn't going that way. (She then put X3 down.)

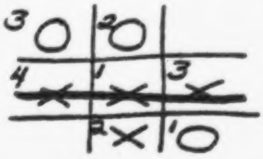
Then I put 03 down to win and she hurriedly puts X4 down.

Danielle: See this is how I was going.

Sandy: But I already win.

Danielle: But you didn't read in my mind!

Game 6 X - first

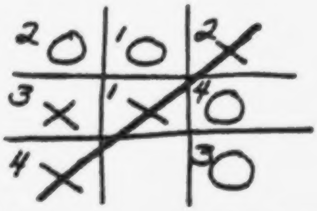


Sandy: Why do you always put the X in the middle first?

Danielle: When my Daddy played with me, he said you can win better when you put it in the middle.

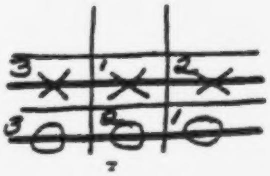
Here she is imitating and really not using strategy.

Game 7 O - first



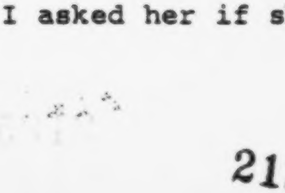
She didn't realize she could win on X3, but when I blocked across on O4, she then saw she could win diagonally.

Game 8 O - first



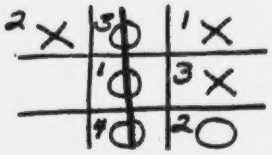
Here she had to put an X on X3 even though I had already won.

Game 9 X - first



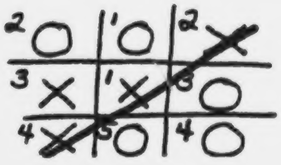
She didn't realize she had won on X4 so we continued and she put the "C" on the game. I asked her if she was sure the cat won and she said yes. I told her to look again. Her sister came up and told her to look diagonally from corner to corner. She then saw where she could have won and drew the line diagonally to win.

Game 10 O - first



She did block diagonally on X2, but I think she was trying to go across the top.

Game 11 O - first



She didn't see she could win diagonally on X3 so I blocked across on O3. She put X4 down and didn't realize she had won so I went on to O5.

Sandy: Well who won?

Danielle: I bet you thought it was the cat but it was me, see!

(She drew the diagonal line.)

When we finished the 11th game, Danielle counted up how many I'd won (5) with my fingers and the number she had won on her fingers (6). I ask her who had won the most and she told me that she had and that I needed to practice a lot more before I played with my kids at school or they would beat me too. NICE KID!

HOW TO USE COMMERCIAL MATERIALS IN THE CLASSROOM

Helen Miller

1. Hide the instructions! (They may be useful later.)

    Instructions tend to restrict a teacher's creative use of the materials. The way in which each child uses the materials to construct learnining for himself should be a teacher's main concern.

2. Share the materials with the children.

    Tell the children how many can use them at the same time--one child, two children, or many. The number of children may be limited by the supplies available and by the developmental level of the children. If the materials are to be returned to a particular place, mark that spot clearly. Children tend to forget.

3. When a child is using a certain material, observe how he is relating to the task of exploring a new tool.

    Children need a great deal of time to examine materials that are unfamiliar to them. This is time well-spent. The free play allows a child to consider all aspects of the tool and to discover some possible ways to use old knowledge and to develop new ideas. (Playing with a new material is a very necessary first step for the child. Whether this free play is planned by the teacher or not, most children will explore anyway, so it is wise to allow time for exploration.)

4. When a child is playing with the material and when he asks a question about the material, reply by asking the child what he

thinks.

Answering a question with a question will provide the teacher with information about a child's level of thinking. This will enable the teacher to guide the child's use of the material in a way that will help him or her to construct learning that is meaningful. The manufacturer of the material cannot attend to every child's learning needs. It is the teacher's responsibility to relate the materials to the child; it is futile to require every child to relate to the same material in the same way.

5. After a child has become familiar with the materials, direct his thinking by asking questions which will extend and challenge his thinking about how he can use the materials.

Example: I had purchased a rubber stamp set called, "Outline Motifs for Pattern Making," manufactured by Philograph Publications Limited, Andover, Hants, England, from DIDAX Educational Resources, Inc.

The children enjoyed simply stamping papers with them. I watched carefully to see how each of them approached the task. Many just tried them all, over and over again without establishing any consistent method of stamping. A few, after awhile, began to make designs; some were making patterns without this having been suggested. One child saw his friend try a pattern arrangement, thought that it was a good idea, and began to experiment with a pattern of his own.

In order to help the children focus on the differences among the stamps, I asked a child if he could color all the motifs on his paper that were the same, that had a line, that had circles, etc. The children themselves devised their own problems for each other, as they began to see the various individual characteristics of each motif.

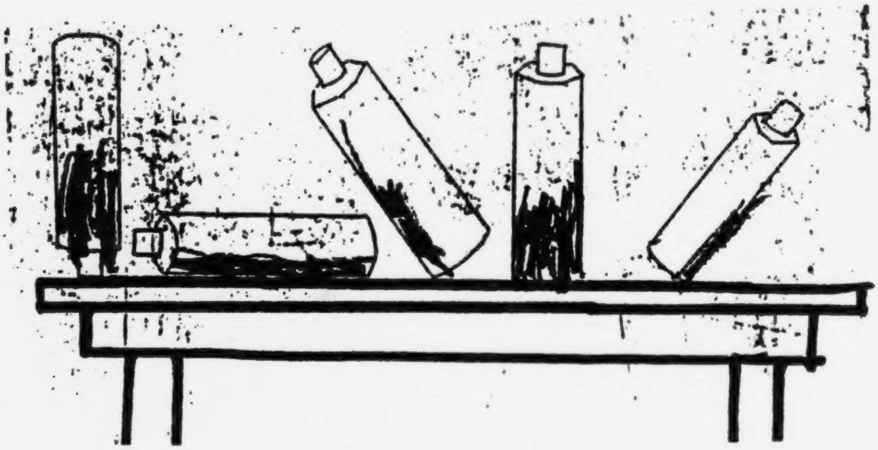
6. If you need additional ideas for challenging a child's thinking, go back to the instructions.

The manufacturer may have ways to use the materials that may now be helpful. Be sure to allow children the option of using ideas or rules that you suggest or using the ones which they have made up. Their own rules may be more meaningful in their construction of learning than yours are! Take this opportunity to listen and to observe how the children are working.

7. Each child's natural curiosity and desire to learn will make any material useful in the classroom.

The main objective for the teacher is to fit the material to the child. One must not demand that the child fit the material.

Grade K - Age 5



"M & M'S--THEY MELT INTO YOUR BRAIN--NOT IN YOUR HANDS

Gail Lockart

One way, I have found, to motivate children in my classroom is by using interesting manipulatives. This is no new trick, as you all know. But when that manipulative is a bag of M & M's, that is real motivation! There is the eventual promise of getting to eat the M & M's when the activity is completed.

Every child was given a package of M & M's. They were asked to examine the package carefully to find out everything they could about the contents from the outside.

This exercise enabled them to discover the weight of the package and its basic nutritional value. Were there additives in the package? What is an additive? Was there anything nutritional in this package? How could you find out?

Before opening the package, each student was to estimate the number of M & M's they thought to be in the package. Then the fun began!

We had been working on graphs in math, and this seemed to be the perfect opportunity to graph and chart. The children divided the candies into colors--orange, yellow, light brown, dark brown and green. They were amazed to discover that although the contents read 4 oz. on the outside, the number of M & M's in each student's bag differed by as many as from 53 to 77 total candies. Needless to say, there were some disgruntled kids who felt cheated by having fewer pieces of candy.

We had discussed bar graphs, pictographs and circle graphs. The students graphed their bag of candies on paper in the three ways and graphing took on a new meaningful light. It gave them a reason to learn how to graph material obtained in research.

One student wanted to write the M & M company to ask them how there could be different numbers of candies in each bag when there was supposed to be a certain weight...consumer education.

Other activities which might be used would depend on the age level. (These were fourth graders.) Extension activities for this math exercise would be:

1. Count the number of candies.

2. Count the number of different colored candies.

3. Make up a problem using the candies. (If you added the orange candies to the yellow ones, how many would you have?)

4. Show a multiplication problem using the candies you and a friend have.

5. Make your own design using your candies. (It will be unique because you have different numbers than the others in the class.)

6. What is the probability of picking out an orange candy from your bag of candy?

7. Set up a fraction showing your green M & M's in relation to a classmate's green M & M's.

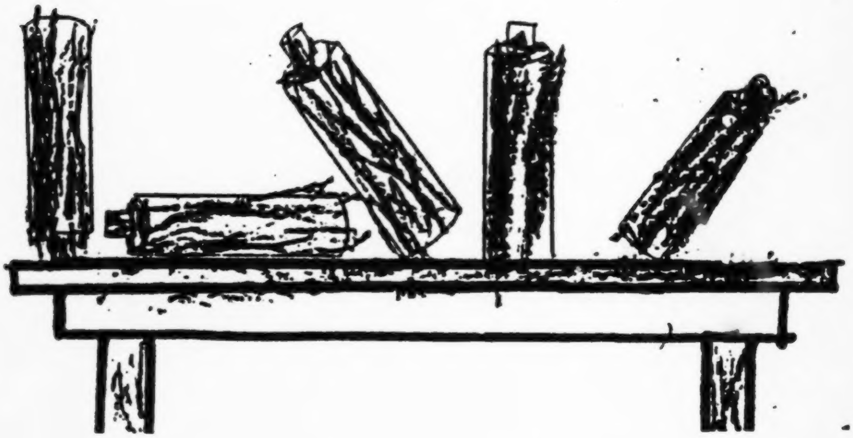
8. How long does it take to melt an M & M in your mouth. Estimate before you do it.

9. How many chews does it take to chew up an M & M? Estimate.

This activity was lots of fun and made graphing and charting a meaningful experience. The students were enthusiastic and interested. They also enjoyed learning in the process.

(Another teacher latched on to this idea and used jelly beans. It was met with equal enthusiasm.)

Grade K - Age 4



UPDATE

Alfred G. King

In my previous article, I told you of the awful misjustices my co-teachers and I had acknowledged as a direct result of activities assigned by Dr. Thomas O'Brien in the ELED 515 Spring 1984 class. The injustice was that we were limiting creativity, stopping teamwork, and generally thinking for our kids.

Thank heaven that the personnel in our building have the seniority, the education (most have Master's), and enough thoughtfulness and spirit to see a major deficiency and demand a change.

On Friday, June 1, 1984, we met with our principal and demanded the following changes:

1. That we leave the time-on-task practice for the first and last 15 minutes per day and return to advisory practice for those times. We feel that this will give us a chance to talk with and have open discussions with the kids, thus encouraging trust from the kids toward the faculty.
2. That we the faculty be allowed to participate in a course prior to the opening of the '84-'85 school year, thus promoting trust and a feeling of working together among the faculty and staff. All fees are to be taken from the school fund.
3. That we bring back assemblies.

Our principal agreed to all of the above demands.

We have agreed to do the following:

1. Talk with people who teach classes that are not so structured. View those methods of teaching. Learn from them.
2. Don't be in such a hurry to have a child solve a problem. Don't let the child know that you are getting impatient with his/her thinking. Keep your eyes off the clock!
   Example: If you ask Johnny to solve $3 + 6 - 7 \times 3 =$, and he cannot answer in a reasonable time, give him an example and ask him to take his time and solve the original problem, maybe at home. Don't solve that problem for him or immediately assign it to another student.
3. Assign more problems that require more than one method of solving, maybe some that cannot be answered in a day or week. That a child may have to work on a problem for a long period of time is closer to real life than the trivial tasks we often assign.

We don't know if we are on the right track or not, but we are willing to change for the better.

If anyone can offer any further suggestions, drop me a card at: 150 Waterford Drive, Florissant, MO 63033. During the school year write: Any Faculty Member, Yeatman Middle School, Carter and Athlone Streets, St. Louis, MO.

Looking forward to hearing suggestions!

AT THE END OF THE YEAR

Linda Shepheard

During the last week of school, I've had a chance to sit back and observe closely the children's interaction with each other. I've watched the children say and do things I have supposed to be attributes of five and six year olds but honestly have never observed.

Observation 1

We have two rooms of kindergarten children. During the last week of school in our P.E. class, I had them running relay races. Both classes were given an explanation of the relay and also told that the class that finished first, won. The children seemed to understand and were excited about winning. We began. I was encouraging my class to "run fast," etc. We all seemed to be caught up in the spirit. As I watched each runner I realized they were competing individually, not as a team. I was hearing comments from the children who had already run like "I beat you, I win." At the end I declared the winning class but many in the other class were pset. "I beated Misty, I get to win."

I mentally reminded myself that children this age are still egocentric. I was thankful I waited until the last week of school to do this activity.

Observation 2

As I was getting my room ready for next year, taking inventory, returning items to the proper places (outside my classroom), many of my children were getting upset. I casually told them I was getting ready for next year's kindergarten class. After some thoughtful looks they asked, "What about me, what am I going to do?"

It is hard for children to look ahead. We had already talked of first grade "next year" but these children could not pull out of one situation and look ahead a few months. They seemed almost threatened by this uncertainty.

Observation 3

Our field trip took us to Grant's Farm. One boy (5.7) was getting more upset the farther away we traveled from the school building. He had only traveled on a school bus from his house to the school. He kept asking if the driver was getting lost and was very unsure of the situation. I tried to assure him that the driver knew where he was going. He then wanted to know if the driver could find his way back home. He could not understand that if he knew how to get there, he also knew how to return home. The driver could hear our conversation and at the stoplight he told Patrick he had taken lots of kids to Grant's Farm and had never gotten lost. He assured him we were safe. Patrick seemed relieved by the driver talking to him.

I wonder how many adults take things for granted with their children. This child was very upset over something adults never seem to think about. We assume the person in charge knows what to do. This child did not. Maybe we would be better off to take on this child-like thought. We wouldn't be led astray so easily.

THE USE OF ATTRIBUTE OBJECTS TO EXPLORE A CHILD'S THINKING

Margaret Nottingham

I attempted to explore the technique and theory proposed by Z.P. Dienes and E.A. Golding who introduced the attribute blocks for the purpose of teaching logic to young children as a prerequisite to more formal forms of mathematics.

There is a set of 48 blocks--each one is a unique member of the set having a unique combination of four attributes--that is: color--red, blue or yellow; thickness--thin or thick; size--small or large; and shape--circle, square, triangle, or rectangle as described in Learning Logic Logical Games by Z.P. Dienes and E.W. Golding.

I made an equivalent set of attribute papers from construction paper where the four attributes were: color--orange, green, and purple; size--small, large; shape--circle, triangle, square, rectangle; stripedness: striped or plain.

I set up a task whereby I could observe the child working with attribute papers.

I gave the child the set of paper pieces and after he or she looked them over I asked him/her to tell me something about them--hoping to get responses of most of the attributes.

I then asked the child to make a row of about eight pieces. In that row each piece was to be different from the one next to it in two ways.

Then I asked the child to make a second row of about eight pieces. In that row each piece was to be different from the one next to it in three ways. Also, at this point, I tried to get the child to explain what were the three ways of difference.

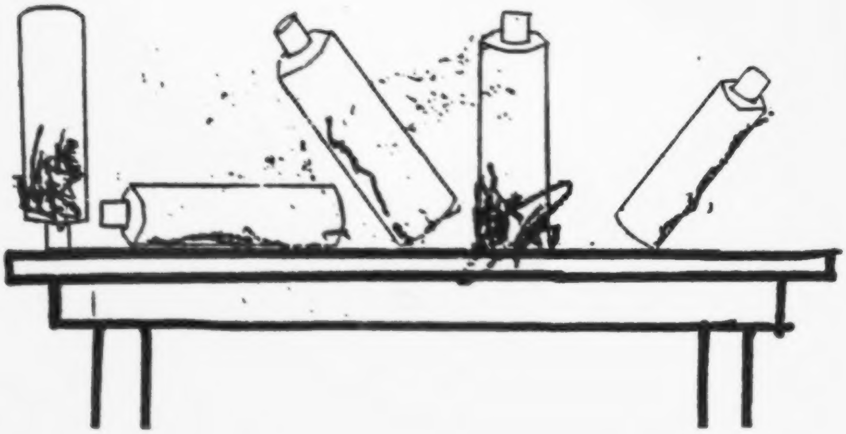
I found that children from first grade and kindergarten gave me the most interesting results. They were the most challenged by this system of logic.

The results of my limited study of this theory adapted as it was, helped define levels of mental development among the children I observed.

The kindergarten student in the experiment showed a great inclination to grouplike shapes and was able to consider two differences among similar objects. One interesting occurrence was when he placed a striped shape down with the lines going horizontally--then he placed a striped shape down with the lines going vertically and announced that a difference in these objects was that their lines were going in different directions. This I feel is very indicative of a maturity level within the preoperational level of mental development of a child. An older child would not be prone to sight this as a difference. He would take into account that he had placed it that way. Another child, a first grader, went through the motions of the task but was somewhat unwilling to completely interact with me on the particular objectives asked. He started the task and proceeded to turn the task to his own objectives of placing shapes that he thought looked "good" next to each other. He seemed intrigued regarding his chosen combinations. In other words, he became so preoccupied with the materials that he subjugated the original objectives of the task to that of exploring the colors and combinations of his own terms. Once again, I feel this behavior showed characteristics of mental functioning at the preoperational stage of development--where a child is less willing to consider another person's point of view--rather he interacted with his own thoughts. A third child who was also six and in first grade accepted the task readily as it was presented and worked very completely within the objectives of the task. I felt that her approach and competency toward the task showed strong signs of functioning within the early concrete operational stage even at six years of age.

I really feel that wooden blocks--as opposed to paper shapes would be far superior equipment to use with children. However, after observing children using elements of this theory regardless of my inferior materials, I feel that this system could be a valuable diagnostic tool to use with young children of about kindergarten and first-grade age to help determine aspects of their mental functioning, especially levels of mental maturity. I'd like to add that such tasks involving this technique should take the form of games, the type children enjoy playing, and the play should be kept interesting, varied, and fun.

Grade K - Age 3



INFORMAL DIVISION

Virginia Breithaupt

During a child watching exercise for the Teacher's Center Project, I had the opportunity to ask my two six-year-old daughters, Michele and Angela, the following question:

> Pretend these pieces of paper (25 paper squares) are 25 cookies. Could you divide them between yourself, your sisters, and your brother?

I guess I should mention that it was not necessary to ask them to count the paper squares because they have such fun counting things that they do it automatically. This was, in fact, a two-part question.

First, they had to decide how many people they were dividing the "cookies" between. Then finally, they had to do the actual division. Here are the results.

Angela, age 6, grade 1: [indicated by A]

Me - [I asked the question above]

A - [She began dividing the squares into 3 groups, forgetting herself. As she began her second round, she spotted her error and started over. She then divided them into 4 piles. The first round was passed out by ones. The second and third rounds were distributed by twos with the last round being passed by ones [out of necessity]. She said, "Each pile has 6 and there's 1 left over."

Me - What will you do with that one?

A - Nothing. I'll just let it sit here [in a pile by itself] until I get 3 more.

Me - Then what?

A - Then I'll give one to Michele, one to Sarah, one to Stevie, and I'll get the other one and put it in my pile.

Michele, age 6, grade 1 [Her response is indicated by M.]

Me - [I asked the same question.}

M - [She counted 5 squares and placed them in each of 4 piles.] I'll start out with 5 and see what I have left. [When she finished the first round she gave each pile 1 more and looked at the remaining square.] They all have 6 with 1 left over. {Before I could ask what she would do with it she said} I know what I could do with it. I could break it up and give all of us a piece.

Me - OK, here's the scissors. Cut it up and give each of you a piece.

M - [She cut the square into 3 strips and cut them into 3 again, giving her 9 pieces. She gave each pile 2 but still had 1 left over. Calmly, she picked up the scissors and cut the remaining piece in half and then into thirds, giving her 6 pieces. She gave each pile 1 but now she had 2 left. Words alone cannot adequately describe the look on her face. As she looked at them a bit puzzled she said, "Now, you put these away."

Me - OK, do that.

M - [She turned to walk away, then quickly turned around again.] No wait a minute! [She took the scissors and cut each strip in half giving her 4 pieces, which she passed out putting 1 in each pile.] "Now, they're all gone! We ate 'em all up!" Next, I decided to try a more simple division problem, 15 divided by 3.

Angela: [A]

Me - [I removed 10 squares so there were only 15.] Now there are 15 squares. Could you show me 15 divided by 3?

A - I can't do it. I don't know how to do it.

Me - OK. Pretend these are 15 sesame candies [her favorite]. Can you divide them between you, Michele, and Selena [a playmate]?

A - Yes.

Me - How many would each of you have?

A - [She distributed them as she had done before, one in each pile on the first round and two per pile on the second and last rounds.] We all got 5!

Michele: [M]

Me - Could you show me 15 divided by 3?

M - 15 take away 3 or 15 plus 3?

Me - 15 divided by 3.

M - Oh, you mean like I did the cookies?

Me - Yes.

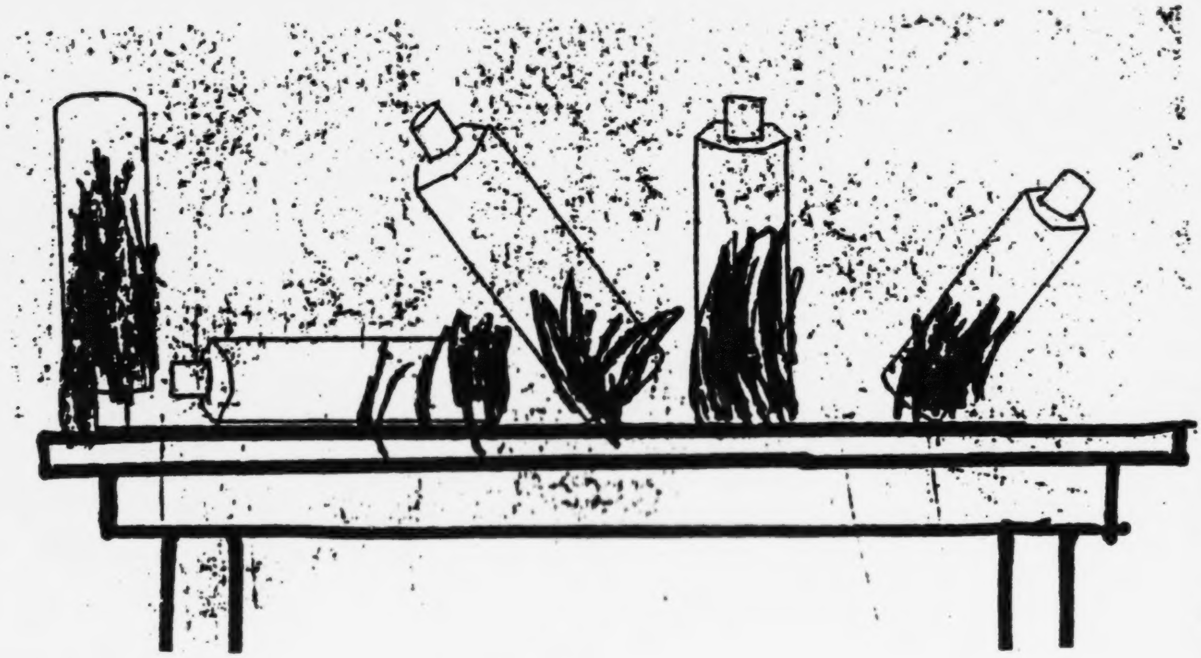
M - OK, give me the scissors.

Me - Do you need them?

M - Well, no. I don't know. [She put 3 in each pile until they were all gone. She was surprised that she had used them all.] She laughed and then said, "Now you can have some cookies, too, Mom. There are 3 in each pile."

This exercise confirmed some of the things I had learned in the Herbert Ginsburg book, Children's Arithmetic . Children's understanding of written symbolism lags far behind their informal arithmetic. Formal mathematics is viewed by children as an isolated activity which is unrelated to any other activity. With these things in mind, we should plan our math program so that we use what the child already knows and build on it. We should use activities that the child is interested in so that he will practice and attempt moderately difficult problems. Then and only then, should we introduce symbolism. Let's make Math something worth doing. Children know more that we give them credit for, but that won't last for long if we burn them out with meaningless drill and practice sheets.

Grade K - Age 5



EXPERIENCING THE SHIFT TO RIGHT-MODE

Bonnie Enos

The concept of right and left-mode information processing was briefly discussed in the previous article. Here are several simple exercises that can help you feel the shift from your normal left-mode thinking into right-mode. You may wish to try them by yourself to get a better understanding of the concept. Children from about ten years old also enjoy and benefit from these exercises.

Vases and Faces

You have probably seen the illusion drawing of a vase or two faces. Look at it one way, you see a vase, another way it is two faces in profile. (fig. 1)

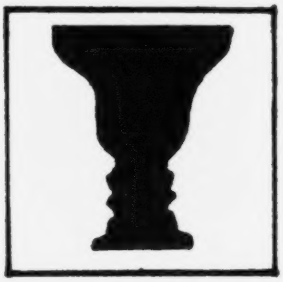


fig. 1

READ ALL THE DIRECTIONS

1. Draw a profile of a person's face on the left side of the paper, facing the center (right side for left-handers).

2. Draw horizontal lines at the top and bottom of your profile, forming the top and bottom of the vase. (fig. 2)

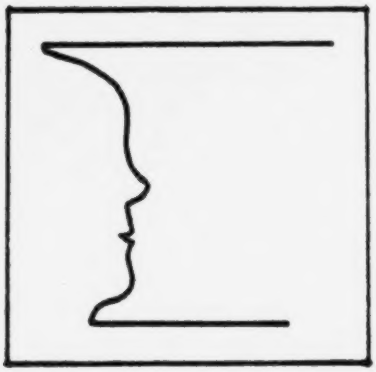


fig. 2 For right-handers

3. Go back over your drawing of the first profile. As your pencil moves over the features name them: forehead, nose, upper lip, lower lip, chin, neck. This is a left-mode task: naming symbolic shapes.

4. Now starting at the top, draw the profile in reverse to complete the vase. It must be a reversal of the first profile to be symmetrical. Be aware of signals from your brain that you are shifting modes of thinking. Do you experience a conflict? How do you solve it? You will discover that you will draw the second profile differently. This is a right-mode activity.

NOW DO THE DRAWING

5. Now that you have completed the drawing, think about how you did it. The first profile was probably done rapidly, drawing symbolic shapes from memory and naming them.

The second profile you probably found more difficult at first. To complete the face you had to almost forget you were drawing a face. You were scanning back and forth between the profiles, judging curves, estimating distances and relating shapes which became unnamed. You probably could not talk and do this drawing. You asked yourself right-mode questions such as:

> "How long is that line in relation to this other?"
> "Where does that line end?"
> "How deep is that curve?"

Could you feel the different way of thinking?

MONSTER FACES

This is just a variation of the first exercise except here the profile is the oddest face you can come up with (a real monster) therefore making it more complex and more of a challenge. (fig. 3)

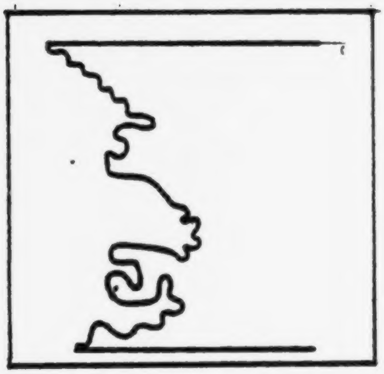


fig 3 For right-handers

UPSIDE DOWN DRAWING

Take a line drawing of a person or object and turn it upside down and copy it that way. The drawing can be a professional one which is more complex than what you usually draw (you will surprise yourself). For children, isolate a section of a drawing. Give yourself a quiet block of time in which to complete the exercise. Background music may be played. (fig. 4)

Look at the drawing for a few minutes before beginning. Study the angles, shapes and lines. When you begin drawing, copy each line. Do not try to name the parts. Just draw each line in relation to each other. See how they fit together like a puzzle. Work on parts adjacent to each other.

You will find that the left-mode shuts off on this exercise. You can really experience right-mode thinking.

Do not turn the paper over until you are all done. You will be pleasantly surprised! (Did you know that forgers turn signatures upside down to copy them?)

SUMMARY

Now that you are in touch with right-mode thinking, how can we now employ this often forgotten way of processing information into other areas of study?

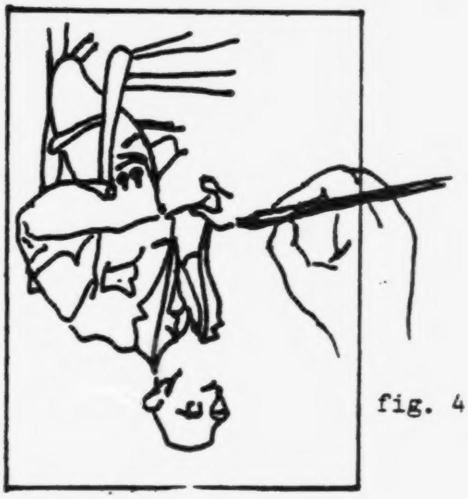
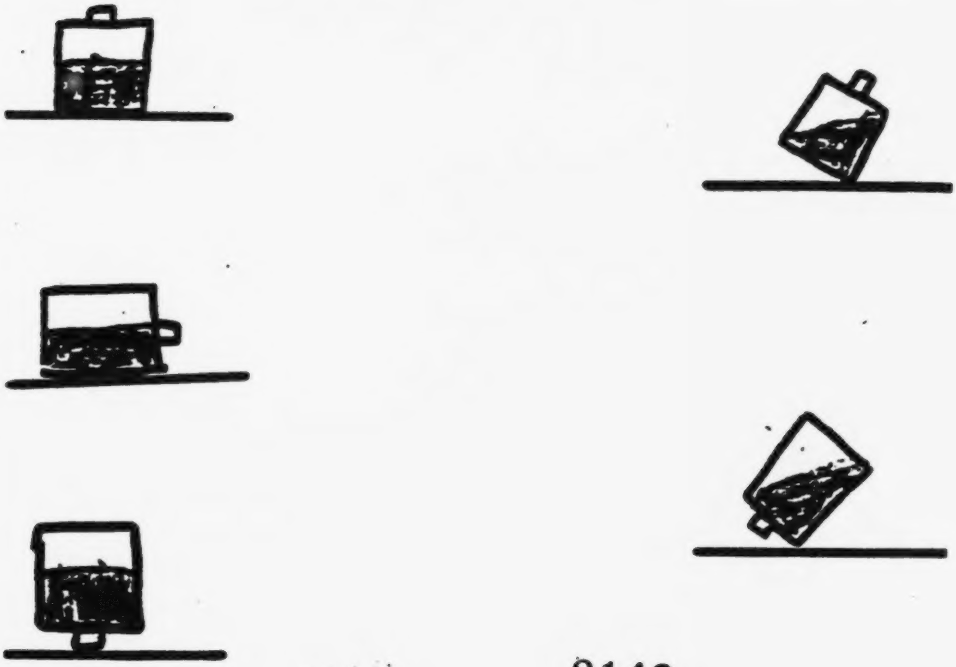


fig. 4 Start of an upside-down drawing of Portrait of Igor Stravinsky by Pablo Picasso

Grade 5



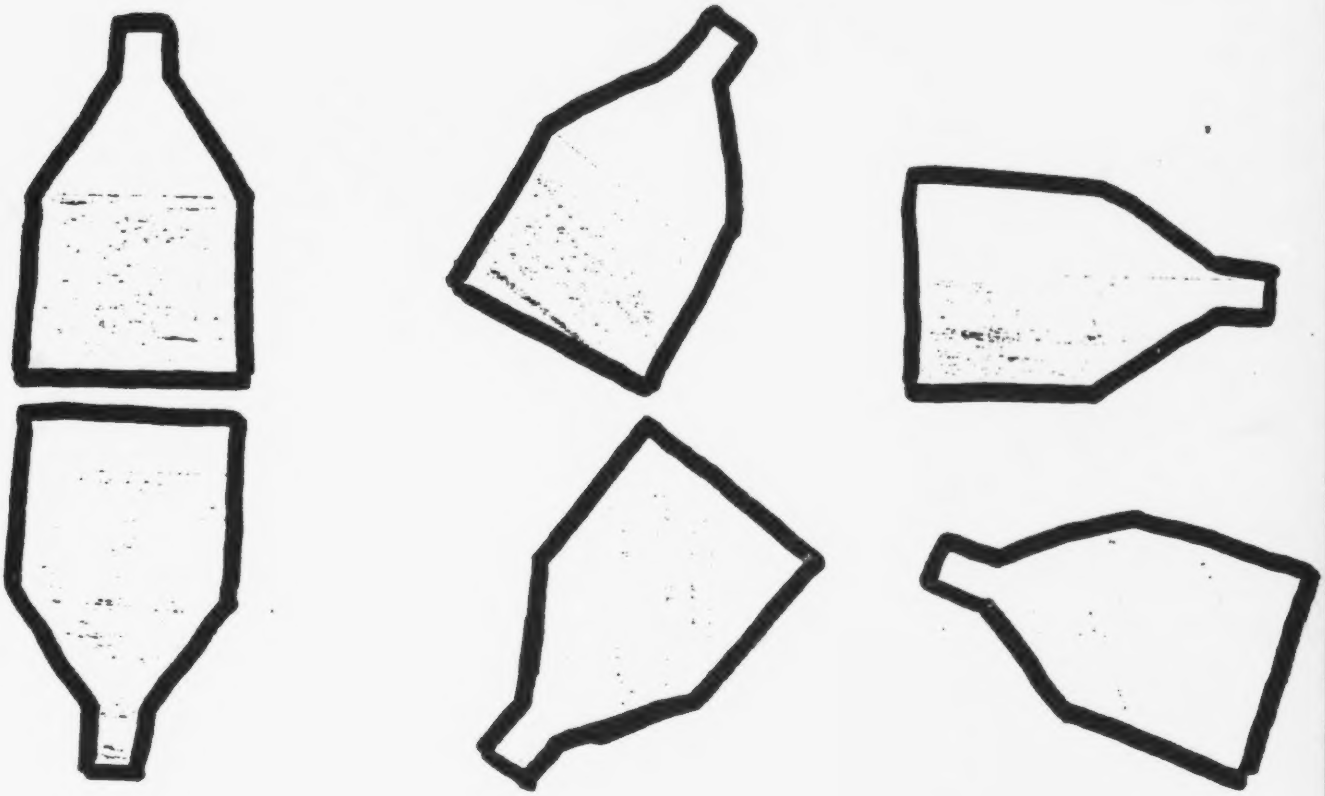
WATER LEVELS

Virginia Breithaupt

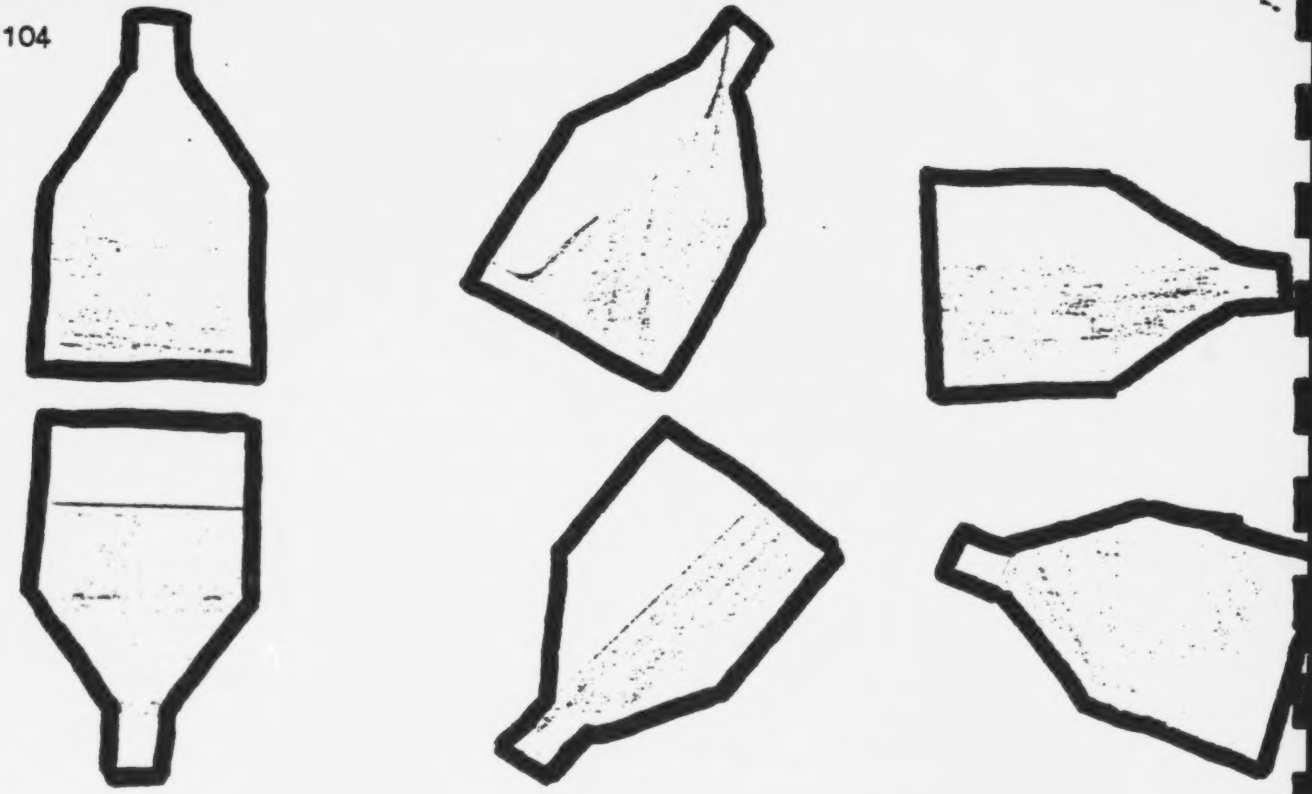
Experimentation of children's thinking and how they perceive things to be has been going on for some time now. One task from Piagetian literature is to have children mark the water level in a bottle when the bottle is in different positions. Well, I tried this task with 6 children to see how it would work in real life.

I sat all the children on the floor in different parts of the room so that each could see my bottle clearly without seeing the other's paper. My bottle contained colored water and each child was given a crayon of the same color and asked to color in the water the same way they would see it. I held the bottle in 6 different positions. I held it in each position until each child was certain they knew where the water level was. They were not allowed to color their picture at that time. When 5 minutes had passed I repeated the same show of bottle positions. Immediately upon finishing my display, the children were allowed to color in the water level. As you view the results on the following pages, keep in mind that these children had seen the same display twice in about 20 minutes and were able to assure me that they knew where to place the water level.

These results can be a bit shocking if you've been used to thinking that children accurately perceive what they see. The fact is, they don't. As Tom O'Brien has said many times, and I must agree, children are not little adults. They deform reality in terms of their mental structures. They are not cameras or x-ray machines. I think it's high time we, as educators, fully realize this. Somehow, somewhere between what they see and what they understand kids get things mixed up. If we are not content to slow down and take time to let children learn, then maybe they never really will.



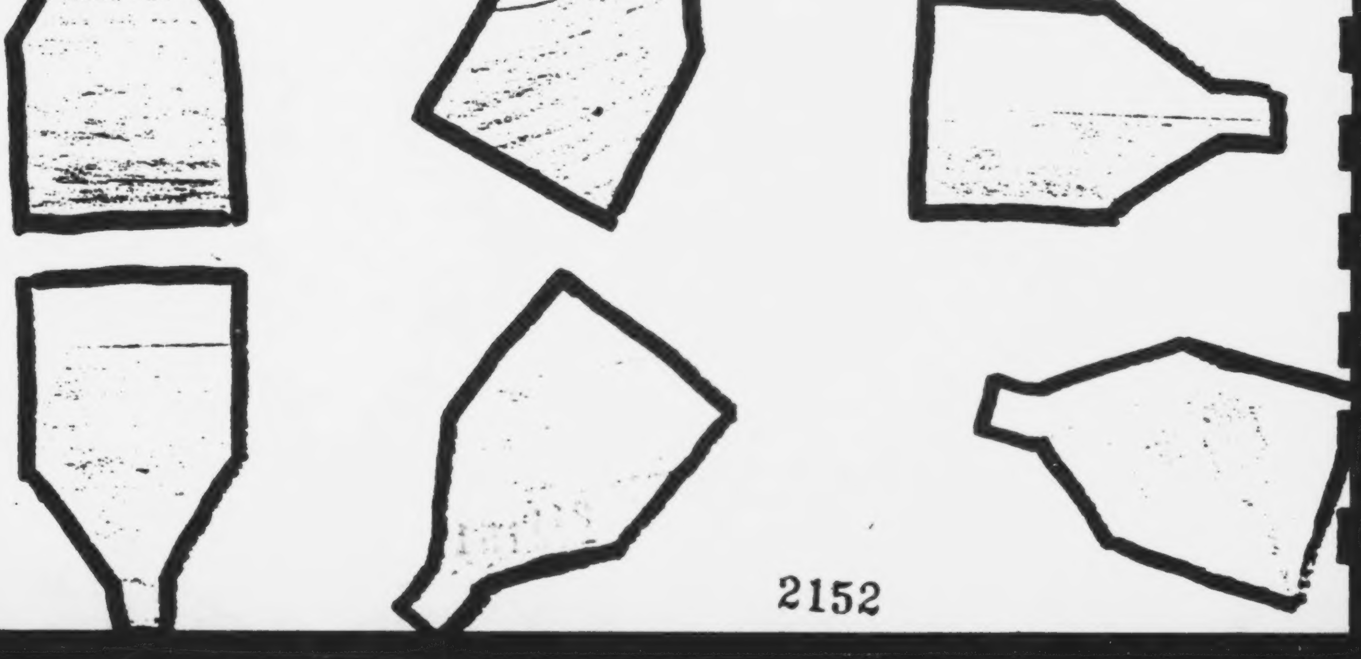
Michele, age 6, grade 1

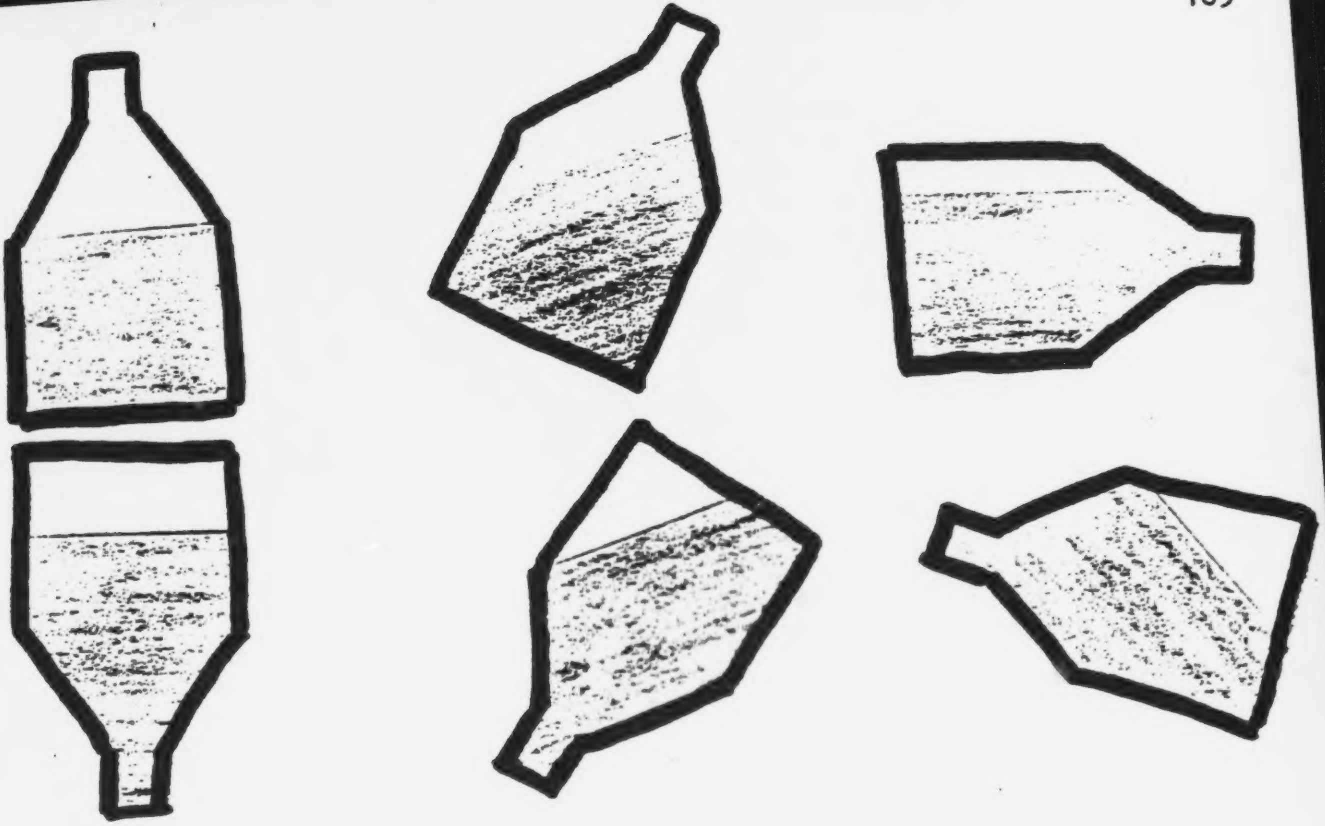


Demetris, age 6, grade 1

* *

Vincent, age 7, grade 2

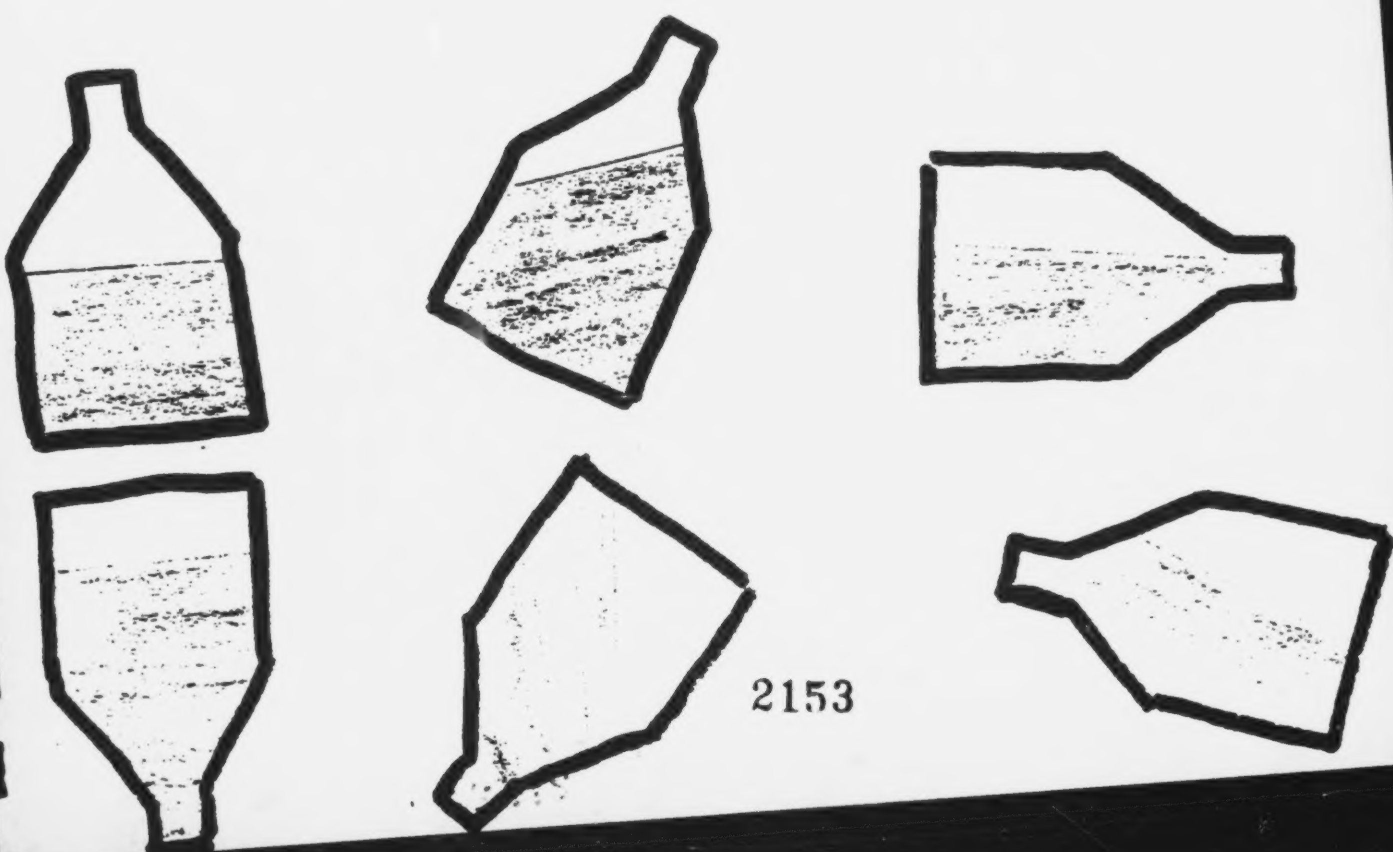




Stacy, age 9, grade 3

* *

Willie, age 11, grade 6



THE GAME OF GRAB WITH VARIATIONS

Original Grab by Bob Jeffrey

Variations by Helen L. Miller

Several summers ago Bob Jeffrey, Principal Lecturer in Education and Mathematics, West London Institute of Higher Education, England, introduced an activity called "Grab" at a Teachers' Center Summer Workshop.

Bob Jeffrey described "Grab" as a game played by 7 year olds to give them a feeling for factoring and for prime numbers. He invited teachers to use this game in a way that is commensurate with the needs of their students.

The activities in this Seedling have been bent, stretched, and adapted for children from 5-7 years of age. These variations of "Grab" have helped the children relate to the following skills and concepts:

1. prime numbers,
2. meaning of "greater than" and "less than",
3. sets of 2,3,4,5
4. estimating
5. counting.

Try these activities and then bend and stretch them in order to facilitate learning for the children in your class.

There is one very important rule. You must share what you have learned with at least one other teacher.

The materials needed to play this game are very simple. For the following variations it is best to have items in two colors-blue and white buttons, or red and white poker chips, or cereal that comes in two colors. Cereal is advantageous because the winners can eat the cereal when they're finished.

This game may be played by a large group of children, by one child (use cards for each direction), by a small group of children when time permits.

After the children have played "Grab" several times, ask them to think about some rules they have used to play the game. The children may suggest new ways that the game can be played.

Grab 1

Each child is given 5 white chips and 5 blue chips. (For younger children it is best to begin by giving each child his own supply of chips.)

Each child puts his chips in a pile in front of him.

Remind the children that they are to take "some". They must not count them before they grab.

Directions:

Grab some chips.

If you have more blue chips than white chips, you win.

Return the chips to the pile.

Grab again.

If you have more white chips than blue, you win.

Return the chips to the pile.

Grab again.

If you have less blue chips than white, you win.

Return the chips.

Grab again.

If you have less white chips than blue, you win.

Return the chips.

Grab again.

If you have the same number of white chips as blue chips, you win.

Return the chips.

This game may be repeated several times The terms "greater than" and "fewer than" should be substituted for "more than" and "less than".

If a child is having difficulty with these terms, begin by using the term "different from". (that is, "If the number of white chips is different from the number of blue chips, you win.")

Grab 2

Each child needs 10 chips, all the same color.

Directions:

Grab some chips.

If you can put them in sets of two without any left over, you win.

(Repeat this game several times.)

How many sets of 2 do you have?

How many chips do you have?

What is the least amount you must have to win?

Now put all 10 chips in sets of 2.

How many sets of 2 do you have?

Return the chips to the pile..

Grab some chips.

If you can put the chips in sets of 2 without any left over, you win?

What is a good number of chips to take?

What other amounts of chips can you put into sets of 2 without any left over? Now use the chips to see if your number was a good one.

Grab 3

Use the same directions as those for Grab 2.

This time change the set needed to win to a set of 3.

Then do the same steps using a set of 4 and then a set of 5.

As the children become more proficient at the game, increase the number of chips each child has to 15. Finally, give each child a random number of chips, or ask two children to share their chips.

Grab 4 (The original game from Bob Jeffrey)

Four children play this game using a pile of cubes or pebbles.

Each player grabs a handful of cubes. The scoring system is as follows:

2 points if you can make sets of 2 with no remainder

3 points if you can make sets of 3 with no remainder

4 points if you can make sets of 4 with no remainder

5 points if you can make sets of 5 with no remainder

That is the end of the game - each [illegible] totals his points.

Grab 5

Each player has 10 chips in front of him.

Grab some chips.

Count the chips which you have grabbed.

How many are left in the pile?

Are there more chips or less chips left in the pile than you grabbed?

Return the chips to the pile.

Grab some chips.

Count the chips in the pile.

How many chips did you grab? Don't count them.

Return the chips to the pile.

Grab some chips.

If you can put the chips in sets of 2 without any left over, you win.

How many chips are left in the pile?

Can you put the chips in the pile in sets of 2?

Return the chips.

Grab the chips.

If you can put the chips in sets of 3 without any left over, you win.

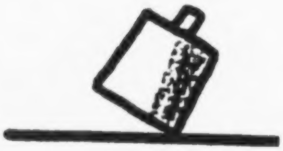
Can you put the chips in the pile in sets of 3 also?

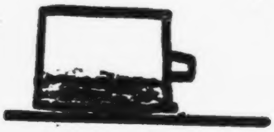
If you had a pile of chips that was the same amount as the chips you put in sets of 3, how many chips would you have?

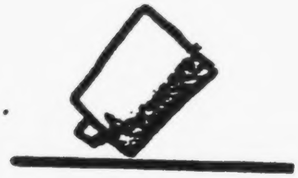
If young children are playing the original game, the beadstrings will help them keep track of their points. The beadstring, which uses 10 beads of one color, then 10 of another color, is a handy tool for computing ones score when any game is played.

Each child should have his own beadstring. Each time a player has a new score to add to previous points, he counts the correct number of beads from the last total. A clip clothespin will hold his place until he is ready to add another score.

Grade 3





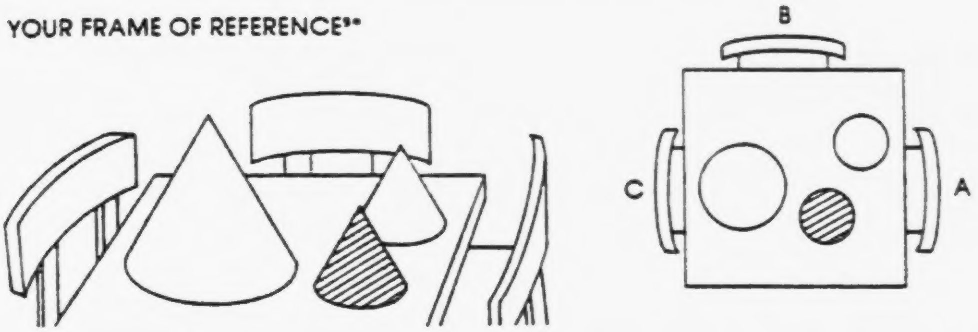


FRAME OF REFERENCE

Margaret Nottingham

This is a problem of perceiving the perspective of a scene as viewed from the three different positions A, B, and C.

1 YOUR FRAME OF REFERENCE**

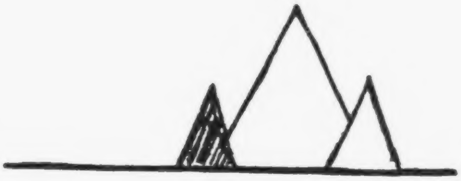


I asked a nine-year-oldboy to look at the two views (above), the table top with various cones on it and to draw what he would see if he were sitting at position A, positon B, and then C.

He said he would like to do it the easy way--showing the table as a straight line.

He was able to perceive well for position A. He overlapped correctly and even made the striped cone slightly smaller than the smaller of the two white cones. This showed that it receded into the background more than the smaller white cone.

A.

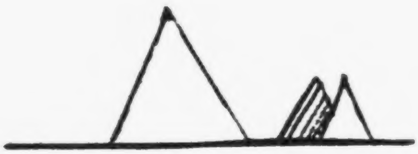


Position A

Regarding position B, he had a right/left mix-up in his perception of what the cones should look like from that view.

He put the large white cone on the left instead of the correct side (the right side). But then he overlapped the smaller cone correctly receding the striped cone to the back of the smaller white cone--also the smaller white cone gives the impression of being somewhat larger than the striped cone. That part he perceived correctly.

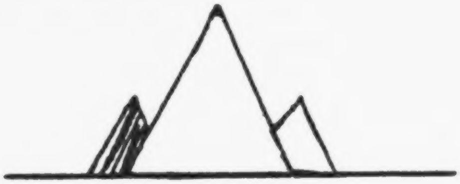
B.



Position B

Considering position C, he clearly saw the large white cone as most forward with the smaller cones further back. Once again he erroneously interchanged positions--this time the smaller white cone and the same-sized striped cone. It looks as though he made the striped cone slightly larger indicating that it was more forwardly positioned than the smaller white cone. His perception of things being forward and receding was portrayed correctly even though his right/left perception was interchanged.

C.

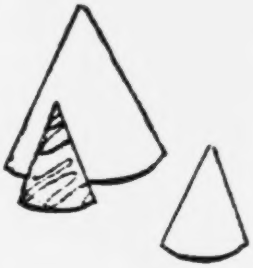


Position C

I then asked a fourteen-year-old girl to make the drawings as she perceived the cones to appear from the A, B, and C positions without turning the picture around.

In position A, generally speaking, the positioning is correct. The smaller white cone is possibly slightly isolated which makes me feel that one is looking forward on to the large white cone with the striped cone in front of it slightly to the left--while at the same time one has a more aerial front view of the smaller white cone. A possible shift in perspective angles in her mind.

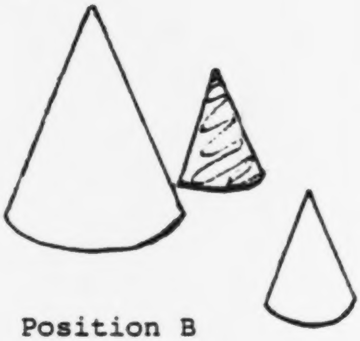
A.



Position A

Regarding position B, she also mixed up the positions of the large white cone and the small white cone as far as the right/left positioning went. However, she correctly receded the striped cone and advanced the smaller white cone.

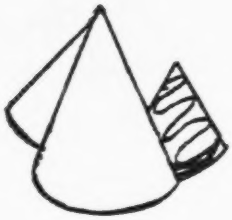
B.



Position B

In position C, the placement of the cones is basically correct. She shows that the striped cone is a little more forward than the smaller white cone by having its base slightly lower; however, she did make the smaller white cone too large in comparison to the striped cone since they are supposed to be the same size and the striped cone is more forward.

C.



Position C

Observations:

Regarding Position B--it is the most difficult position in which to visualize the location of the objects on the table because one has to visually turn the arrangement "upside down" in the mind.

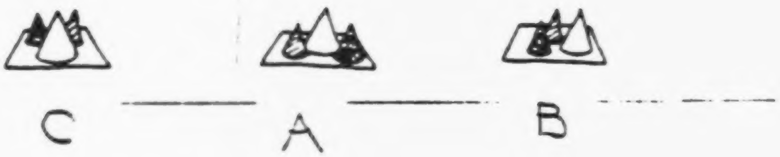
There seems to be two mental functions at work regarding Position B. One involves accomplishing the right to left reversal to visualize the location of the objects from the B position. This seems to be the more difficult of the two functions especially when combined with the mental function of accomplishing perspective.

This is assuming one does not turn the picture of views around, upside down or walk around the picture which, surprisingly enough to me--neither child expressed a desire to do.

The second mental function is that of accomplishing the perception of perspective--that is, of visualizing depth-objects forward in relation to those receding in the background and, in regard to Position B, visualizing the perspective "upside down."

Both children accomplished the visual perspective correctly even though they had to visualize it "upside down." This seemed like the easier mental task. Both children had the greater difficulty mentally reversing the objects from right to left position when they had to visualize the objects from an "upside down" view. This seemed like the more difficult mental task. This posed a question in my mind, Could two human minds, in general, more easily accomplish a vertical reversal than a horizontal reversal? Or are they different aspects of thinking-function one and function two?

I did a follow-up on this task, merely asking both the nine-year-old and the fourteen-year-old to pick out the correct pictures illustrating the different views or positions A, B, and C. With just a slight hesitation, they both picked out the correct pictures.



Response of the nine-year-old boy

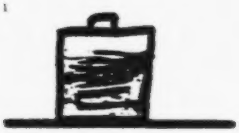
C A B

Response of the fourteen-year-old girl

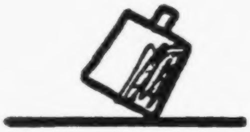
These prompt correct responses made me feel that when the brain is helped, guided along, as if kept on the correct thinking track--in this case, by a limited number of visual cues--the chances of correct response are much greater. There seems to be two-and-a-half factors involved--one is the visual picture itself, substantiating the child's mental image along with the limited array of answers where in this case, the process of illumination can come into play since all three answers are correct respectively to the three various positions.

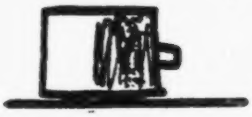
Reference

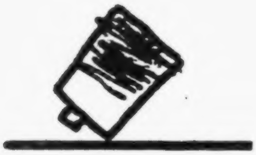
Labinowicz, E. The Piaget Primer: Thinking, Learning, Teaching, Addison-Wesley Publishing Company, Menlo Park, CA, 1980, 71, 78.

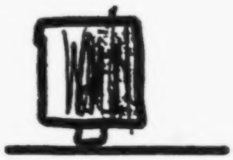


Grade 5









OLYMPICS 1984

Gail Lockart

"The 1984 Olympics are beginning this week. Our class have made up some questions and puzzles for you to do. You will need to use an encyclopedia, the Olympic guide book and your own knowledge to figure out the answers. GOOD LUCK!"

This paragraph was on the outside of a manila folder filled with activities developed by 4th and 5th graders from Project Challenge, the gifted program in our district. Even though the 1984 Olympics are part of the past as you read this, Olympics are a high interest topic which students like to find out about and become involved in.

Part of the goal of the gifted class is to learn their own strengths, develop them and share them with others. The class was highly challenged to learn trivia about the Olympics, discover past history of the Games and to use this information in some puzzles which would hopefully stump the regular 4th grade class and challenge them to do research to come up with the answers.

One student came up with a word scramble which gave names of some of the events in the Winter Olympic Games.

1. liaonthb
2. eugl
3. iingsk
4. gniddelsbob
5. peeds tiagnks
6. eic ykeoch
7. eurigf ktangis

Another came up with a "Design your own Olympic Symbol and share it with the class.

An elaborate 13 by 16 square grid was developed by one of the students with hard to find Olympic words worked into a word search.

Design a uniform for the U.S. Olympic participants to wear in the opening parade. This brought the summer Olympics into view and gave the artistic student an opportunity to shine.

A crossword puzzle used Olympic information to try to stump the students.

Read the clues on this page and fill in the blanks to spell a word.

CLUES:

1. The town where the Olympics are being held. - - - - - - - ☐
2. What is being held? - ☐ - - - - - -
3. The country where the Olympics are being held. ☐ - - - - - - - -
4. The opposite of winter. - - - ☐ - -
5. Fast skating. - ☐ - - - - - - - - - -
6. Our country. - - - - ☐ - -
7. Where the Summer Olympics are (state). ☐ - - - - - - - - -
8. What Dorothy Hamill does in the Olympics. ☐ - - - - -

When the clues are filled in, the boxed letters spell a word to do with the Olympics.

One student wanted to test the students' ability to research information given the materials. He listed ten questions which he felt were good questions.

The questions are as follows:

1. Locate Sarajevo, Yugoslavia on the map.
2. Locate Los Angeles, California.
3. What is the biathlon?
4. When did the first Winter Olympics begin?
5. What is the difference between a bobsled and a luge?
6. Using an encyclopedia, where were the Olympics held in 1904?
7. What was the date that the Olympics were held in Los Angeles before 1984?
8. Why were there no Olympics held in 1910, 1940, and 1944?
9. When were the first Summer Olympics held?
10. What does the Olympic symbol stand for? Explain why the rings are linked together and why they are colored the way they are.

There were two ornate mazes developed by two artistic students. One was in the shape of the Olympic torch and the other was an intricate maze in the shape of the five intertwining circles.

The fourth grade students were given the opportunity to do all activities though no pressure was put on them to finish all activities. At the end of the week students finishing all problems were given a gold medal. Those finishing at least half received a silver medal, and those completing only a few received a bronze medal.

Both classes benefited from this experience and it was basically a student centered experience with the teacher entering only as a facilitator.

How Many Under Cover?

Ginny Breithaupt

Mathematics, for the most part, is seen as an isolated subject. Usually, it means very little to the children learning it, unless, of course, it is seen as a game. One example of this is the answer of a 9 year old boy. I had asked him if he could give me an example of 14 + 3 and how would he use it. He told me that if a man came up to you on the street and asked you "What is 14 + 3?" you tell him 17. This may seem extreme but it's true. This sort of thing comes from a child's not having constructed that addition happens in places other than a practice sheet.

Well, I wanted to see if my twin daughters had constructed any mathematical knowledge since I had allowed them to count and manipulate objects. Here's what I did:

Angela, grade 1, age 6 (A = Angela)

Me: How many paper clips are there? (I placed 10 on the table).

A: 10.

Me: (I covered 6) How many are there now?

A: 4

Me: How many are under cover?

A: (She thought awhile) I think 6.

Me: Why would you say 6?

A: Because here are 4 and 1 more is 5 (held down 1 finger) and 5 more is 10 (held down 5 more fingers).

Me: OK, how many now? (I placed 15 more on the table).

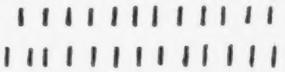
A: 25 (Counted each one by touching and moving them).

Me: (Cover 13) How many now?

A: 12 (Counted by two's to 12).

Me: How many are under cover?

A: (First she tried "thinking". Then she took a pencil and drew 28 random lines on a paper. She crossed 3 off because she had too many. She then realized that placing the lines at random was going to pose a problem in counting so she wrote the lines in this formation:



She circled 12 and counted the rest.) Laughing, she said 13.

Me: Are you sure?

A: Yep, I know that trick. Let me see (pulling my hands off the covered clips). Yep, see 1,2,3,4,5,6,7,8,9,10,11,12,13!

Michele, age 6, grade 1 (M = Michele)

Me: How many clips are there? (I placed 10 on the table).

M: 10.

Me: (cover 6) How many now?

M: 4.

Me: How many are under cover?

M: 6 (quickly).

Me: How do you know?

M: It's gotta be 6 because you had 10 and you got 4 left.

Me: OK, how many now? (I placed 15 more on the table).

Me: 25! (counted by touching and moving each one).

Me: How many are left?

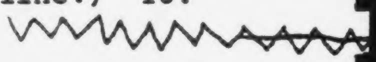
M: 15 (used same method as Angela).

Me: Are you sure?

M: No, I put my lines so close I can't count 'em right. Let me do it again.

Me: OK

M: (She wrote her lines like this and crossed them off as indicated by the red pencil marks. She counted each remaining line.) 16!



Me: Are you sure?

M: That's what I keep getting.

Me: OK, check. (She lifted my hands to reveal other clips.)

M: (She counted each one) Yep! 16 (laughing).

This activity proved to me that Michele and Angela can figure this sort of problem out. At first I had planned to only do the 10 minus something problem, but when it was hardly a challenge I decided to try the 25 minus something (picked randomly) problem. I was pleased to see they have constructed a way to find the solution. Six weeks ago, they were not allowed to count objects or tally marks or anything like that. Now, since I have allowed them to use bead strings and count paper clips, they have learned how to actually solve problems without using rote knowledge alone.

MORE THAN ONE WAY TO GET AN ANSWER

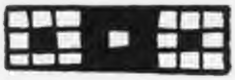
Sandy Kinder

I decided to break my third-grade class into five groups and asked each group to count different items in our building. Group I counted the lockers on the first floor. Group II counted the tiles on our classroom floor. Group III counted the students in grades K-3. Group IV counted the seats in the auditorium. Group V counted the books in a bookcase. I told them I didn't care how their group got the answer, but I did want to know how they arrived at their answer.

These are the ways that each group arrived at its totals:

Group I counted each section and added the totals to come up with their total.

Group II started out counting each tile individually but realized that this would take a long time. One boy noticed that there was a pattern in the tiles that looked like this:



They then decided to count how many sections there were. After they were finished with that, they thought they had the total. One girl said after awhile that they weren't done because they had just counted the sections and that they were supposed to count all the tiles. One boy told the group that there had to be at least 1000 and it would take too long to count them all. Then one girl counted how many squares were in each section (9) and said that they could count by 9's. She stepped on the first section of 9's and said "9" then jumped to the next and said "18" then "27". She was then interrupted by one boy who told the group to wait, he ran to his desk and got his calculator. He asked how many squares they had counted and was told "112" so he keyed into his calculator 112+ and then cleared it and keyed in 112 x 9 =______. When he announced the answer to be "1008," the boy who had told them that there were at least 1000 said, "I told you it was at least 1000." I know he was delighted with his estimation because his eyes were gleaming.

Group III went classroom to classroom and got the total number in each room. They then added each number to get a total of students in grades K-3.

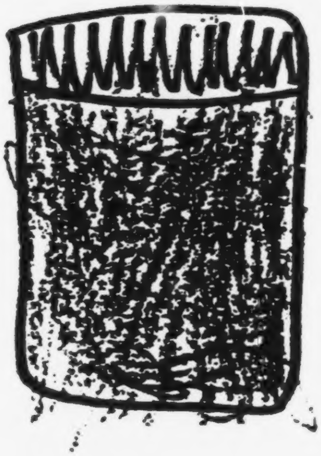
Group IV counted each section of seats individually and then added the three totals together to get their answer. But after hearing what Group II did to get their answer, one girl said to another who was also in this group, "I told you we should have counted each row, then multiplied."

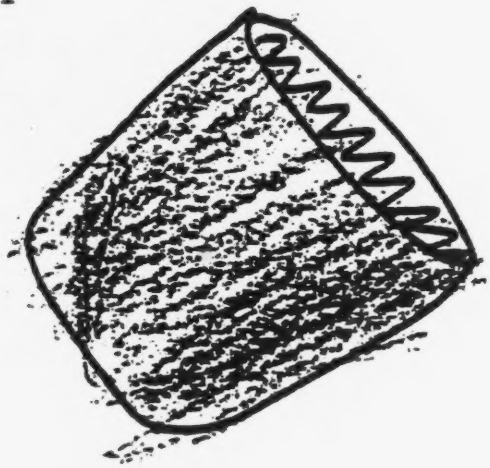
Group V counted the number of books on each shelf and added the numbers to get their answers. I say answers because they had different answers because no one wanted to work together.

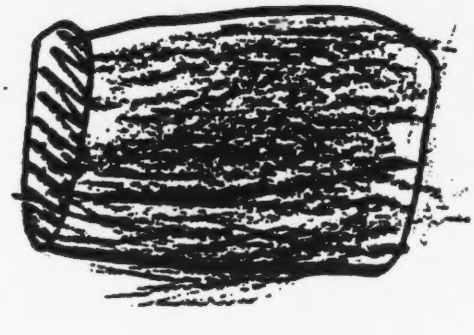
At the end of this activity, we had a discussion on the fact that there is more than just one way to get to an answer. We also discussed that some ways may be quicker than others, but the correct answer and their understanding of how they arrived at that answer are the important things.

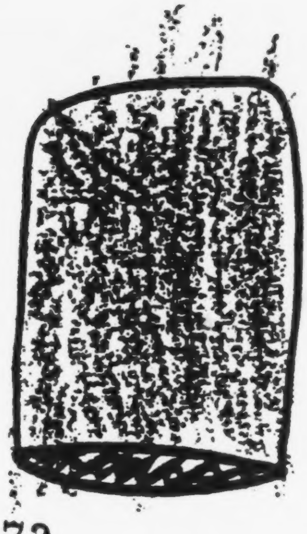
Note from Tom O'Brien: In April 1984 I had the opportunity to chat with Professor George Polya, one of the major figures in mathematical problem solving. Now 95 and nearly sightless, he spun a magical one-on-one seminar, posing problems and solving them in four or five different ways. "One of the most important things to tell teachers, Tom, is to get them and their students to solve problems in more than one way. Even if a problem looks easy--perhaps especially if it looks easy--see if you can find several different solutions," said Polya.

Grade 1









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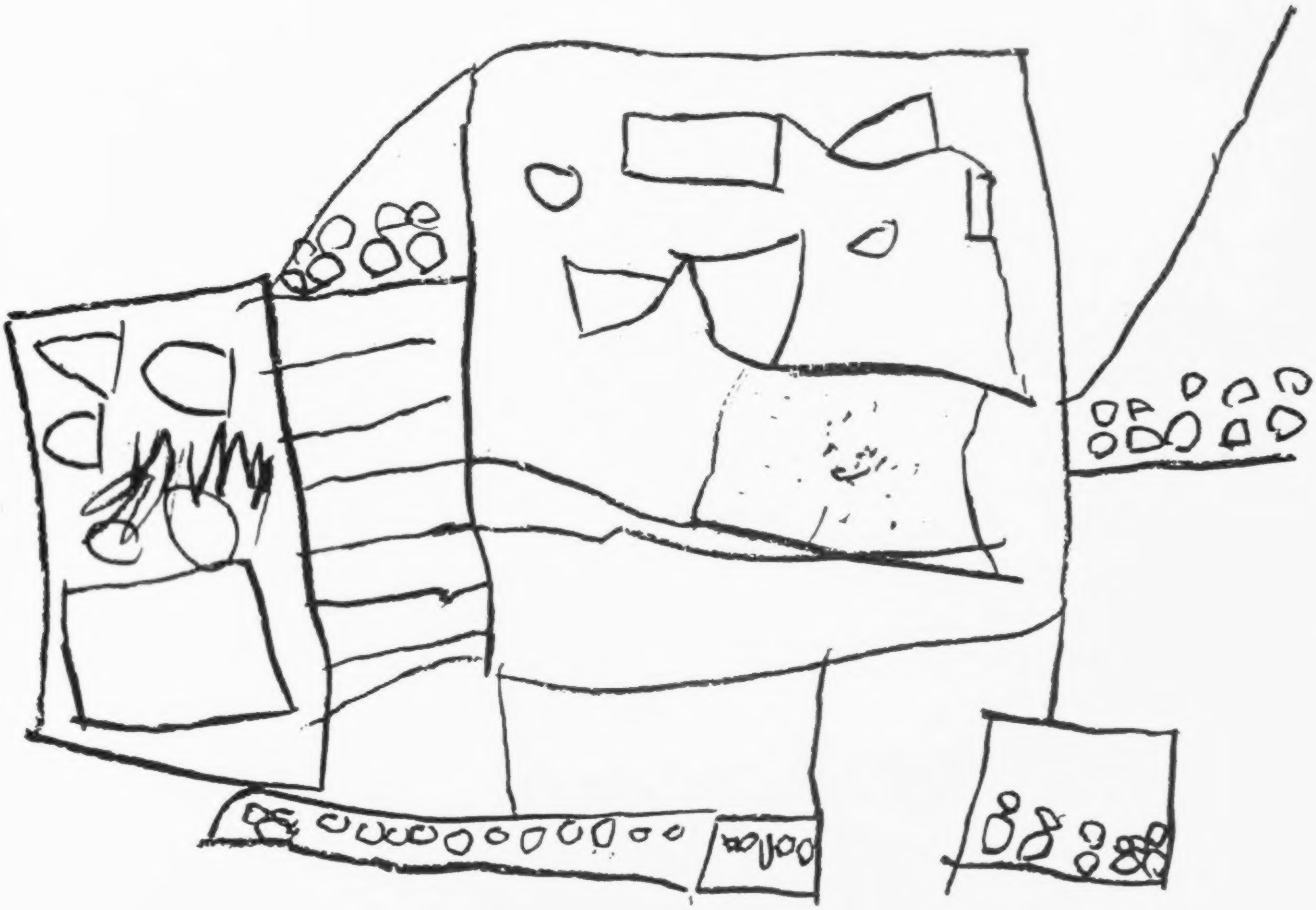
A Computer



Drawing by Danny (age 5)

SEEDBED

2176

SEEDBED

NUMBER 21

November 1984

Teachers' Center Project

SIUE

Southern Illinois University
at Edwardsville

Rain

Shield

Sheet.

Don't print.

INTRODUCTION

This is the first time in a long time that I've handled a SEEDBED all by myself. Yikes, proofing and editing and corraling art and arranging for typing and printing! Shirley Casey, I miss you.

But it's a labor of love. To make available teachers' ideas on behalf of children's growth is a wondrous opportunity.

Herewith we present two SEEDBEDs.

SEEDBED 20 grows out of the work of Teachers' Center participants in the spring of 1984 (with an occasional piece from earlier-days 'cos previous SEEDBEDs were too crowded).

There are several things worth noting in SEEDBED 20. First of all, the cover art was originated by Teachers' Center participant Ginny Breithaupt's twin six year old daughters. Ginny gave her kids some dotty paper and asked them to make of it what they could. Pretty imaginative, yes? What can you learn about Angela and Michele from their artwork?

The CUTTINGS in SEEDBED 20 -- as CUTTTINGS sections in previous issues -- are excerpts from the diaries which Teachers' Center participants keep each week. Rich stuff, both in their content and quest. Engage these diaries and catch the flow of teachers' growth on behalf of children's thinking?

What are the drawings at the foot of the various articles in SEEDBED 20? They're the results of teachers' interviews of children on the classic Piagetian "tilty cup" experiment. What happened was that teachers presented transparent cups half filled with colored fluid to children at various ages. The cups were tilted as shown, in full view of children, and the children were asked to draw -- on pre-prepared ditto sheets -- what they saw. Rather unbelievable, aren't they? There are a lot of developmental details one could go into, but the most important aspect of the research is that many of the children's pictures show situations which could not exist in earthly reality, which children could never have seen in real life. The point is that the mind is NOT a camera. Children -- as we all do -- interpret reality in terms of their existing cognitive networks. (Ginny Breithaupt's article, late in SEEDBED 20, gives a fuller explanation of the research.) What do you make of the pictures? Why not try some similar research yourself? Should we continue, as teachers, to act as though children's minds were cameras?

SEEDBED 21 is the result of our Teachers' Center summer 1984 session concerned with computers and the development of children's thinking. Again, you see teachers growing and sharing their knowledge on behalf of children's thinking. Again, you will certainly see lots of stuff you've not seen elsewhere.

The cover art is a picture of a computer drawn by five-year-old Danny at Teachers' Center participant Peggy Funkhouser's early childhood school in East Alton.

The artwork at the foot of various articles was drawn by teachers and local students with the Koala Pad, an amazingly versatile and captivating graphics microcomputer tool.

And, as an extra bonus, SEEDBED 21 draws on the work of three Teachers' Center friends, Hassler Whitney (Institute for Advanced Study) and Mieko Kamii (Wheelock College), and Stephen Rowland (Leicestershire Education Authority).

A brief word about Stephen Rowland. I met him at the annual meeting of the Association of Teachers of Mathematics in London in April 1984 and thought his paper, reprinted with permission herein) one of the most thoughtful pieces I'd seen in a long time. "Can I reprint it in SEEDBED," I asked. "I'd be delighted," he said, "but Tony Kallet is already planning to print the piece in Mountain View Center's OUTLOOK. Better ring Tony." Upon return, I phoned Tony Kallet, who said, "Of course, print the article. The more widely good stuff travels the better!"

Subsequently I learned about Stephen Rowland's book, "The Enquiring Classroom" (Falmer Press, distributed in the US by Taylor and Francis, Philadelphia). It's not only superb in itself but it's part of an eight volume Falmer Press series on education which demands to become better known by American educators.

SEEDBED 21 also makes available news of the widely praised new research "The Second Self" by MIT sociologist Sherry Turkle. Read the review and rush to your bookstore!

Warmest thanks to Jean Wigger, who handled much of the production of these two SEEDBEDs and who went way beyond the call of duty, as usual, in her labors, and to Patricia Atkinson and Diane Jacober, who typed much of the first draft of these articles.

Engage and enjoy what's here. Knowledge is not a spectator sport.

University City
22 October 84

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COMPUTER SOFTWARE IN EDUCATION

Glen R. Cornelison

School's out, the kids are loaded on the buses and gone for the summer. I get home from school and my wife says, "Well, I guess you are going to SIU this summer". I say, "No way, I'm tired of school". Famous last words.

The SIU announcement came and I looked through it. Tom O'Brien's Computer Software in Education caught my eye. I had a course with O'Brien before and enjoyed it.

I teach Elementary Art and I have a computer lab next to my room. The students who go in there were having a lot of fun. I thought this course would help me get my foot in the door to computers. The first two days of the course we worked in groups reviewing educational software. What would be useful for the classroom? What is junk? "Look at the quality of the software and not the cute graphics." Being an art teacher I was looking more at the cute illlustrations. All these neat monsters, bugs, cars, trucks and people. At the push of a button they tell you if you are right or wrong. They jump and they soar. They follow your commands. That was OK but I would like to know how the illustrations are made.

Mary Steffen asked "If I would like for her to bring in the Koala Pad". Having worked with Mary before in my district and knowing that she kept snakes in her room, I didn't know what to expect. We were brown bagging it and I didn't know if I should bring in a bag of fresh encalyptus leaves for the Koala. The next day Mary handed me a small blackboard-looking pad and a pen. I was relieved that it was not a bear.

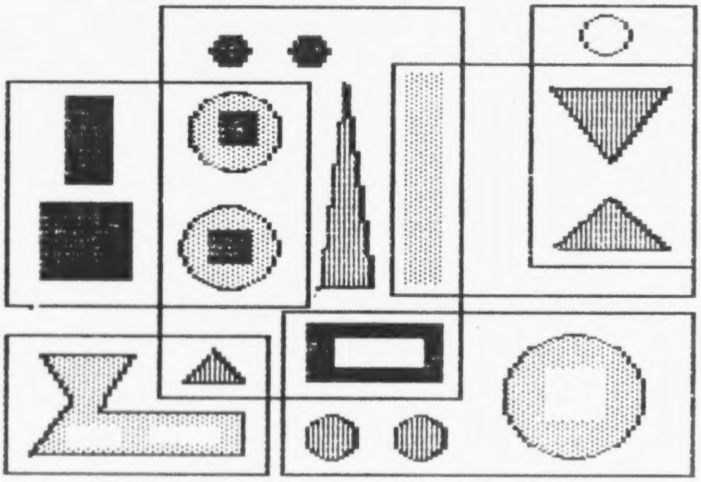
Mary connected the Koala Pad to the Apple computer and put in the disc. On the screen the menu appeared. I wasn't too excited yet. Mary gave me some instructions on how to move the cursor around the menu in order to draw free hand. She was called away and I started to experiment with the pad.

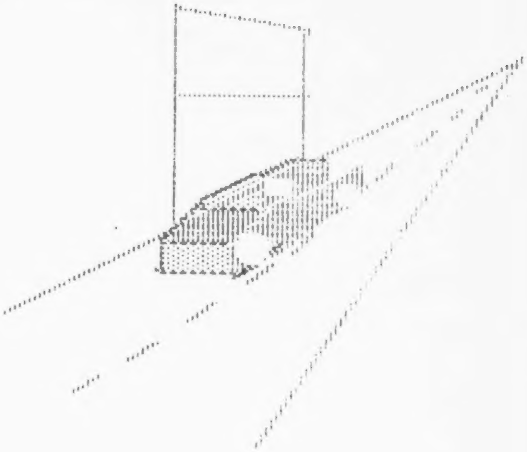
How Neat! Squares any size I wanted and where I wanted them. Wow! Add a circle here or there. Now fill them in with colors. Now I was really getting excited. As I was playing around with the pad, other students started to look over my shoulder. "How are you doing that?" they asked. I showed them how to move the cursor to get the different shapes and colors. I became the Koala instructor for the class. The other teachers in the class were getting excited about what was happening on the screen also. One time when I took a break, O'Brien saw me move away from the screen. He shouted "Hurry, everyone, into the next room for class discussion. Glen is away from the Koala Pad".

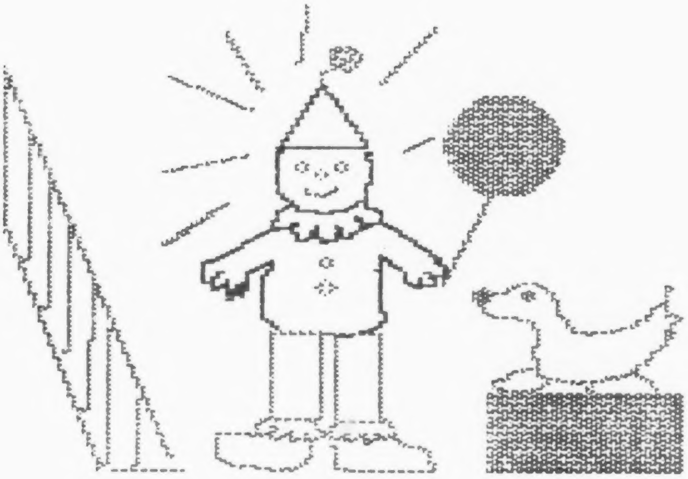
Now this is what I will want to do with my students when we get back in the fall. I will have to work on the PTA to buy the school a Koala Pad. Kids' designs can be used in the Art Department and can be used by the newspaper staff for the school paper. The office and library can use it in endless ways for bulletins. The thing is magical!

I hope when the buses start rolling again in the fall that I can tell the exciting news to my students that we have a Koala Pad.

A what?







IN DEFENSE OF COMPUTER LABS

Judith K. Hall

In my school, the computers, the software, the computer books and the magazines are kept in one classroom aptly named "The Computer Room". No one person is the overseer. Each class schedules time in the room as often as they desire. Each class is responsible for keeping the room in order by returning software to its original place, turning off the computers when finished, etc.... Even though many people criticize labs for computers, I defend the computer room for the following reasons:

--maintains enthusiasm
--better situation for my easily distractable children
--opportune situation for me to observe my class on the computer using software or programming.
--not tracking down, moving and setting up of equipment
--the class and I are actively learning together

My kids are very excited about computers, as are most kids, and I think the lab situation maintains this enthusiasm. They do not have to watch and hear others enjoying a computer-oriented activity knowing that they have to wait until 'their' day to experience that activity. Instead, the entire class at one time shares in the excitement, and sometimes frustration, of computer interaction. I do not put all the children on the same piece of software at the same time. Each group is doing something different, and word travels fast as to what is good, interesting and challenging, and the group has the option to change their piece of software whenever they choose.

Another point in defense of the lab is that this year I have had several highly distractable children in my class (including one who is attending special classes to help him cope with his severe distractability) and if I had only one or two computers in my room each day for a specified time, these children would go wacko if it were not their day to be on the machine.

While the kids are enjoying themselves, I too enjoy myself. Once everyone is organized and working, I can stand back and watch individual children interact with the computer, the program, and the other children in the group. There are many important things which I can observe and make mental notes. For instance:

*children having problems interacting successfully

*a certain skill needing more coverage

*thinking processes improving

*children who are particularly adept on the computer

*children who are 'hogging' the machine and not allowing others to experience keying in information

*children who are non-users due to lack of interest or opportunity

*which pieces of software are good or bad in my mind

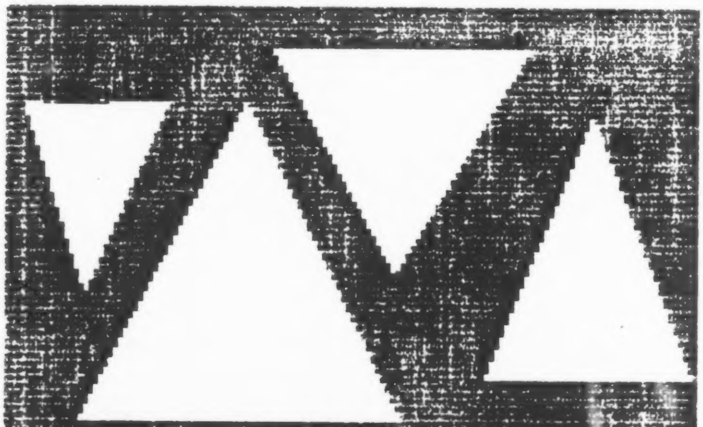
*which types of software my kids enjoy the most

Many of these I could not observe if only one or two computers were available, because I would be involved with the teaching of the rest of the class who were not on the machine that day.

This lab situation works out especially well on the days I bring just a small group to The Computer Room to run the programs they have written. This way, they each have their own machine to program on and time alone to think it through. I then walk around observing again, and offering words of encouragement, suggestions, or help.

I really see a lot of profit in having a Computer Room set up this way. I do not have to do any tracking down of machines that were not where they were supposed to be, nor do I have to move and hook up any machines, so time is not wasted.

We all look forward to our daily trip to the Computer Room not only because it is a change of pace to move to another room, but because of the interest and excitement experienced in the computer-related activities. The computer is a tool that both my kids and I need to learn to use and I enjoy the learning we all share with each other as we forge through the mechanics of this wonderful educational aid together.



WHAT IS COMPUSERVE?

Pam Stanko

CompuServe is, without a doubt, one of the most remarkable things I have ever seen. I saw it demonstrated in Tom O'Brien's class and was thoroughly impressed.

CompuServe is a computer related system that (among many other things) enables one to send or receive messages across the country within seconds. It also enables you to tap into the current news, bulletin boards, even vacation lodging in the US and abroad. The information that you desire appears on your computer screen and you are involved in a totally new way of communication.

CompuServe is available at a small hourly rate and local telephone charges in over 300 cities in the US and Canada. A CompuServe Kit can be connected via modem with most home personal computers. A customer to this service is given a special access number and password. Using your telephone, you dial a local access number and wait for a tone. Then place the receiver into place on the modem. Next, instructions appear on the screen to take you to one of many specified areas.

Instant financial information on major companies--including stock and bond quotes--is now at your fingertips. You no longer have to wait for the morning paper to read about such things. Shopping can also be done through this service. There are 30,000 items from which to choose. Banking at home is possible also, as is the entire official airlines guide (Flight schedules, cost, etc.).

The services go on and on. Current weather reports and sports items are available when you want to know them. You may also send electronic mail to friends and collaboratively write a book with pen-pals.

In all of this, the local access number puts you in touch with CompuServe headquarters in Columbus, Ohio, where all the processing is done.

Also included in the service are a wide range of games that can be played by several parties, not necessarily in the same city. You may choose to play Scrabble, War Games, and many more.

CompuServe products are available in local stores such as Sears and Wallenbooks and in most retail computer shops.

Charges for the service are determined by the number of minutes used, $6.00 per contact hour for non-prime time (i.e. outside normal business hours). Billing is done through one's personal credit card. Business and financial reports plus some news reports carry an added charge.

I expect the use of CompuServe will increase steadily across our country. Presently, its time and energy saving qualities make it appealing. But in the future, it will be a necessity.

COMPUTER CAMPS

Carol Platzkoester

With the introduction of computers in my classroom this year, many parents have asked me for information concerning computer camps. Computer camps for children and adults are very "in" and I knew nothing about them. After checking with teachers in the area who are teaching computer classes this summer I learned that computer camps are not the only or necessarily the best way to learn about computers. In our area more and more schools, colleges and YMCAs are offering classes, workshops and day-camps that are educational and fun at as little as 1/10th the price of sleep-away camps. Sleep-a-way camps may cost as much as $900 for a two-week session. However, since computer camps are the latest fad, many children and parents will still be interested in them.

What can parents expect to get for their money? It depends on how much the student is willing to put in. A child will not learn just by being there, but if they want to learn a lot, they will. Much of what the student will learn depends on the computer knowledge they have before they go to camp. A beginner may learn how to program in BASIC, write simple games and make graphics. More advanced students will learn complex languages. Most camps spend at least four hours a day programming or in a classroom learning to program. If the student is enthusiastic, it would be very hard not to learn. Getting a lot for your money doesn't just depend on how much a student is willing to put into it. The quality of the camp or course chosen, and how well suited it is to one's needs, are just as important. There are many other things that parents and teachers must look for and ask about before selecting a computer camp.

Hardware is important to ask about. Be sure to ask what type of computer the camp or school uses. It would be frustrating for a child to come back to school in September and not to be able to use what they have learned. Most camps have more than one type of computer. If this is true, it is important to ask if you are allowed to choose the type of machine the child will be using.

Another important point to consider before choosing a computer camp is student/computer ratio. The ideal student computer ratio is one to one. That way, you can work at your own pace. I have observed, however, that working in pairs does have its advantages. Children share their ideas. If there are more than two on a computer, this may be a disadvantage. It could lead to frustration, and some children may not get enough time on the computer.

Another important question to ask is the age range of students at the camp. There are many camps for children which offer programs also for adults. Some camps are only for adults. Sixteen year olds may find themselves sharing a computer with a nine year old. Or a child may be the only girl in a classroom full of boys.

The instruction given at these camps is also important. Instructors with teaching experience are better teachers usually than computer graduate students. Grad students may know a lot about computers, but little about communicating with children. The best camps will have a teacher who has some computer experience and a computer grad student as an assistant. This pairing, would make ideal instruction.

A good recreation program is also important when selecting a computer camp. Computing must be balanced with recreation. Some camps don't have facilities for recreation--swimming pools, softball fields, etc.

When you are finished separating the wheat from the chaff it is important to remember what the child is interested in learning and find a camp which offers a program that suits him.

Word of mouth is sometimes a good way to find out about computer camps in your area. There are also many other ways to get information about camps. The American Camping Association publishes a yearly guide to accredited US camps. One helpful source is The Computer Camp Book. This guide lists a number of classes, camps and workshops. It's available (for $12.95, plus $2.00 postage) from:

The Computer Camp Book
P.O. Box 292
Yellow Springs, Ohio 45387

Using all of the above information, you should have no problem in locating the ideal computer camp for your students.

INEQUITIES IN FEMALE COMPUTER USE

Sarah Leitner

Do boys and girls differ in their approach to computers? Yes. Here is what I learned from reading The Computing Teacher.

Although boys and girls use computers equally in the early grades, the situation changes during early adolescence. At this age, female students show less interest in computers and tend to avoid elective classes in computing and advanced mathematics. As a result, many females leave school with limited career choices and traditional female roles are reinforced.

There are three reasons why girls seem less interested in and less willing to use the computer than boys: 1) bias in the software; 2) social bias, stereotypes, peer pressure and boys' behavior; and 3) content and structure of programming as an introduction to computers.

The majority of software concentrates on competition, aggressiveness, violent action and loud noises. Girls prefer fantasy, word-oriented rewards, and completion tasks (where the object is to finish something). Software should be selected that appeals to girls as well as boys.

Most of the messages that surround computer use are male oriented or stress mathematics. Advertisements on television and in computer magazines usually show men and boys as the users of computers; girls rarely appear or appear as the observers. These advertisements can be analyzed in the classroom and students can be asked to write letters to those companies which use blatant sexism in their ads.

Positive role models should be provided for female students. Bulletin board displays should show men and women using computers in a variety of ways. Guest speakers should include computer professionals who are female. The fact is that many of the leaders of the computers-in-education movement are women executives.

Parents are often more willing to invest in a home computer and computer training for their sons than for their daughters. A survey of computer camps found that males outnumbered females three to one, and that the more expensive the camp, the fewer females.

Parents of female children should be encouraged to consider the possibilities of a computer camp for the summer. Also, male and female students can demonstrate computer use for their parents. Teachers can encourage female students to act as instructors for parent workshops.

Realizing that boys are usually more aggressive computer users than girls, teachers must make sure that all students receive equal computer time. Teachers may have sign-up sheets in their room or may reserve the computer center for girls on certain days.

Since there are few courses from which to choose, many times girls don't find the courses they take to be interesting or relevant.

Studies show that girls find little immediate practical use for simple programming skills and would rather learn applications programs for word processing, database use, or graphics.

There is less female inequity in classes where LOGO, rather than BASIC, is used to teach programming concepts. The graphic nature of LOGO seems more appealing to girls than an algebraic language such as BASIC.

Even though computing is a relatively new field, it is often thought of as a male activity. There is a great deal that the classroom teacher can do to help eliminate sexual stereotypes that many people have about computer usage. The teacher can help female students have an equal chance to receive the skills needed in our computer-oriented society.

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AN AID IN OVERCOMING COMPUTERPHOBIA

Mary Masterson

Is the computer something to be feared or is it something to be used? Many people, especially teachers, have Computerphobia. Their fears are generally self-imposed and most are unwarranted. If you suffer from this syndrome, please read on. I will list a few of the fears and offer suggestions on how you might help yourself in overcoming these fears.

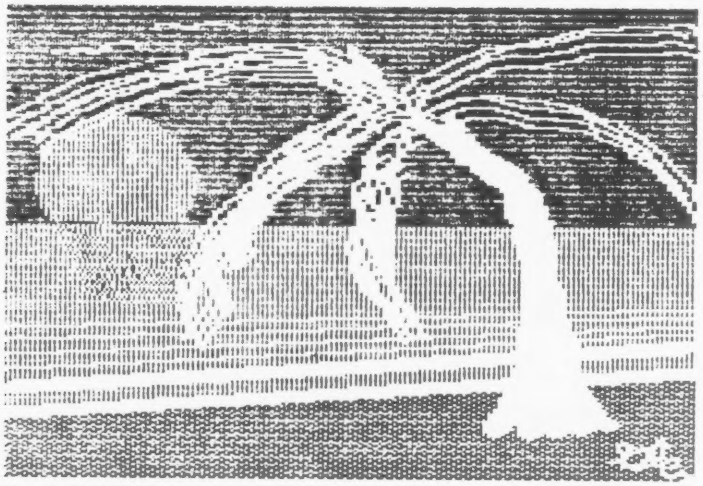
One fear that is prevalent is the "I don't know anything about the computer." Take heart, you don't need to know how to program in order to use the computer. You don't even need to know a computer language or what the technical terms mean. Basic knowledge is all you need to know to use the computer in a classroom. By basic knowledge I mean how to turn the computer on, how to boot the disc, how to respond to the disc's activities, and how to shut the machine off. Once you realize you can handle these steps you will begin touching and working with the computer. It's all just as simple as turning on your home TV.

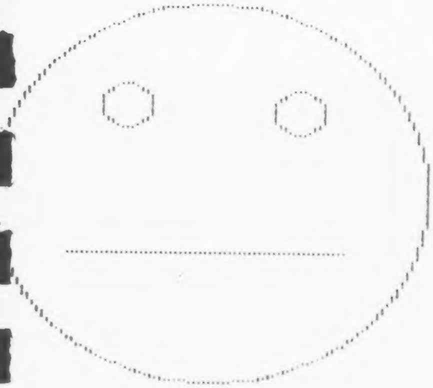
The next fear that makes itself known is "This equipment is expensive. What if I destroy or damage it?" It is really not simple to destroy the hardware. In fact, short of spilling something on the keyboard or dropping the hardware, there's little damage you can do. So if you never eat or drink around the computer or use it for a basketball, then this fear should be quelled. Now the next fear to be conquered involves the floppy disc. "What if I ruin the disc?" These are a bit easier to damage. However with a little caution, nothing will happen to them. To insure the safety of the disc, remember these rules: hold the disc only on the label, never touch the disc itself, don't write on or bend the disc, don't lay the disc near a magnet or on an electric appliance and store the disc in the dust cover in a cool area. When you type on the computer, the information will not be stored on the disc unless it is told to do so. You can't erase the information on the disc simply by typing. If you keep these rules in mind the disc will probably have a long lifespan. If by some remote chance a disc is ruined, all is not lost. Most companies provide a back-up disc.

The next fear to overcome is "What if someone in my class knows more about the computer than I do?" This might well be the case but don't allow their knowledge to intimidate you. Rather, utilize their knowledge to the maximum. Allow this computer whiz to instruct and supervise a small group. While this small group interaction is occurring, you can observe his techniques and ease of dealing with the situation. Through this observation you can learn to feel more confident of your own capabilities.

The last phobia I will deal with involves "I'm afraid I don't know what to use the computer for in my classroom." This fear is unfounded. Remember the computer is best when it is used to teach things you normally have a difficult time teaching. You don't need it to issue tests. At first you might use it as a supplemental aid and then expand your use.

I hope these suggestions will aid in you conquering Computerphobia. If it has not been successful then I suggest you enroll in The Teachers' Center Project. If it has been successful, join The Teachers' Center Project anyway.





COMPUTER SOFTWARE REVIEWS

Program Title: Hurkle

Source: MECC

Recommended Grade Levels: 4-6

Reviewer: Marge Schaefer

Hurkle is a small character who appears on the screen at the begining of the game. He tells the player that he is going to hide on either a number line or a grid and the player must try to find him in 5 tries or less. The player is given the choice of a horizontal line, vertical line, 10 by 10 grid, or -5 by +5 grid. While the Hurkle is hiding music is played.

If the user chooses the horizontal or vertical lines, they name a number on the line. If they are incorrect, they are told to either move north or south or to move east or west depending on the type of line they have chosen. If they choose one of the grids, they are given clues such as go south east. When using the grids, students see how to plot points and write coordinates. When the student finds the Hurkle, music is played and the Hurkle appears shaking his fist at the player.

This program can be used to teach students how to locate points and to reinforce the use of directions. Students really enjoy the Hurkle character and like to meet the challenge presented in this game.

Program Title: Interpreting Graphs

Source: Conduit

Recommended Levels: High School and up according to the publisher

Reviewer: Marge Schaefer

Interpreting Graphs is an excellent piece of software that is designed to expand the user's thinking skills. It gives the user an understanding of graphs in everyday situations. The program relates graphs to events.

Three line graphs are shown on the screen. A brief description of an event is written below the graphs. The user selects the graph which best represents the event given in the description.

This software is suggested for High School level, but I think it can successfully be used at the fifth grade level and above.

This program does not teach graphing ie. plotting points on a grid. Rather, it asks the user to visualize relationships between two variables in a situation.

Program Title: Cloze-Plus

Source: Milliken Publishing Co.

Recommended Grade Level: Reading Levels 3-8

Reviewer: Marge Schaefer

Cloze-Plus is a program designed to improve the reading comprehension and vocabulary of students with third to eighth grade reading levels. The program is made up of six sets of diskettes, one for each of the grade levels. Each set contains four disks which include twenty lessons for that grade level.

The program uses the cloze technique of leaving out certain words in a paragraph or story. The student uses context-analysis skills to determine a word which would fit in the sentence. The student is either asked to give a multiple choice answer or to type in a word. The words typed into the blanks must be spelled correctly. For each correct response, a portion of a puzzle picture is uncovered. When all of the blanks have been filled in correctly, the picture will be complete. If the student makes an incorrect response, he can ask the computer for a clue. The computer goes back in the story and underlines particular contextual clues which will help the student give an acceptable answer. If the student is not correct the second time, the answer is given to him. Throughout the program additional information is given to explain why a certain word must be the answer.

At the end of the lesson the student is given a summary of his/her correct and incorrect responses as well as the number of clues they asked for. For the teacher, there is a listing of eleven skills that are used throughout the program, and the number of correct and incorrect responses for each.

I find that the students enjoy working with this program because of the graphics and the variety of types of questions they are asked. They are sometimes frustrated when they are marked incorrect because of a spelling error.

Program Title: Haunted House

Disc Title: Microzine

Source: Scholastic, Inc.

Recommended Grade Level: 4-6

Reviewer: Alana Bussmann

Haunted House is a graphically exciting program. The students are presented with the situation that one of their friends might be in a haunted house. They have the option of going to help their friend, staying home, or taking out ghost insurance. If they stay home, the game is over. If not, they eventually end up at the haunted house. There are many adventures along the way and they may even come in contact with a joke-telling ghost. The students are given choices every step of the way. What happens in the end depends on the decisions made. There are twists to the plot and some surprise endings.

I felt that the graphics were great and some of the jokes were even funny. However, with the exception of showing how different decisions can affect the outcome, I couldn't see the relevance of the program. At the end of the game I found myself saying, "So, what?"

Program Title: Opposites

Disc Title: Square Pairs

Source: Scholastic, Inc.

Recommended Grade Level: 1-6

Reviewer: Alana Bussmann

Opposites is a challenging memory and concentration game for ages 7 to adult. Players are given many options of how to play. You can play alone or with others. You also have the choice of sound off or on. This is especially useful when there are others in the classroom working on different projects.

After making the choices, players are presented with a game board of numbered boxes. Each player uncovers 2 boxes - if they match he gets one point and continues until he makes a mistake. Players take turns until all of the boxes have been matched and uncovered. At the end of the game, the players' names and scores are displayed and the computer plays, "We're in the Money".

I found this game to be most useful in my special education classroom with first and second graders. It was interesting and really held their attention. They were able to work alone and remembered the information that they had been given. Another added plus that this game has is the fact that teachers can substitute words or phrases. This would make the game useful in all subject areas.

Program Title: Multiplying Whole Numbers

Disc Title: Development of Basic Math Skills, 1

Source: Society For Visual Education, Inc.

Recommended Grade Level: 4-8

Reviewer: Sheila Ballard

In this program five multiplication problems with 3-digit multiplicands and 2-digit multipliers are presented. The student is asked to copy the problem and find the product with pencil and paper. If a correct product has not been entered after two attempts, then the program guides the student step-by-step through the operations (multiplication and addition) of the problem.

Multiplication is generally taught from right to left. This program asks for the entry of the product from left to right. This can be confusing to students beginning 2-digit multipliers.

I do not see where this program has any advantage over a math ditto, as most of the work is done with pencil and paper. The only advantage would be that a computer rather than the teacher points to the errors.

Program Title: Gulp

Disc Title: "Math Fun"

Source: Edu Fun! Milliken Publishing Co.

Recommended Grade Level: 2-6

Answer twenty problems correctly as fast as you can. Otherwise the big fish will feast on your mistakes. The little fish keeps his lead as long as you continue to correctly answer the problems. Wrong answers and slow responses speed up the big fish.

If you are able to save the little fish, you get to play a bonus fishing game. In this game your skill at fishing nets you as many numbers as you can before the great white shark eats your hook and all your numbers.

In this game the emphasis is on speed rather than knowledge. I found myself fumbling around for the right key trying to beat the big fish. Some children might enjoy the pressure placed upon them but I didn't.

Choice is given player of type of math problem, add, subtract, multiply, or divide, and level of difficulty.

Documentation was satisfactory.

Program Title: Dirty Words

Disc Title: "Square Pairs"

Source: Scholastic Wizware

Recommended Grade Level: 3-6

It isn't what it sounds like in this concentration type game of matching. You see, the dirty words are smog, pollution, grime and others that really do mean dirt. Your goal whether playing alone or with an opponent is to find boxes that match. With a partner, the one who finds the most matches wins the game. There are twenty boxes in this game with ten pairs of words.

You may choose options of letting the computer play, playing with sound or without sound, or revising the game with your own words.

Instructions are on the disk for saving the games you've created on a separate disk.

A fun way to practice memory skills.

Good documentation comes with disk.

Program Title: Square Pairs

Source: Scholastic Wizware

Recommended Grade Level: 7-12

Reviewer: Barbara Ogden

"Square Pairs" is a series of matching games. Much like the familiar game "Concentration", it is intended to develop one's memory. The best feature of this game is the options provided the player or teacher. The number of players or words used in a game may be changed, or a new game may be created and named. Revisions or new games can be saved on this disk, but at the price of another being deleted. Key functions are presented with each game, so they do not have to be memorized. They provide for re-viewing the previous word or seeing all pairs matched. The directions for play are easy to follow.

There is no negative feedback if a player does not make a match, but a running total is kept of the number of tries and the number of matches. There is a "bleep" and the words flash if a match is made. The words appear on the screen so the player can concentrate on them at his own pace before moving on.

This is a program worth the investment. It can be used to teach antonyms, synonyms, homonyms, like shapes, equivalent fractions--the list is endless.

The "Square Pairs" disk comes with an easy-to-follow directions booklet, complete with illustrations and examples. It can be used by students or read to younger or less able readers.

Program Title: Turtle Tracks

Source: Scholastic Wizware

Recommended Grade Level: 4-12

Reviewer: Barbara Ogden

"Turtle Tracks" teaches computer programming. By following the easy, step-by-step instruction booklet, students learn to write series of commands that move the "turtle" to create various graphic designs. Utilizing many of the features of both LOGO and BASIC, this could be used as an introduction to the more "sophisticated" languages. Each section of the instruction booklet (including one on color and one that makes the turtle "sing") ends with several challenges for the student to attempt. Possible solutions are included in the back of the booklet.

The student paces himself--either taking more time to practice or in viewing the text screen of line statements and commands.

The ease of use, the options of various characters, colors and sound, and the variety of designs limited only by the students own creativity make "Turtle Tracks" a fun learning tool.

Program Title: The King's Rule: Mathematics and Discovery

Source: Sunburst Communications, Inc.

Recommended Grade Level: 6-adult

Reviewer: Barbara Ogden

"The King's Rule" is a game requiring critical thinking skills as one generates and tests hypotheses about a series of three numbers. There are six levels of difficulty, providing practice at unlocking increasingly subtle rules. However, no level requires mathematical knowledge above a sixth grade level.

This game can be played by one to four individuals or teams. Team play may be noisy, but it is best to share and test as many hypotheses as possible before stating the "King's rule for the numbers. Students ask questions, test their hypotheses and can ask for a recap of the data. Solving three problems at one level gains the student access to the next difficulty level, or room in the "King's castle. The goal is to pass through each room of the castle, meet the King and solve the problems he presents.

There are several teacher options to using "The King's Rule". Sound may be added to or deleted from the feedback, and higher difficulty levels may be closed to some students (i.e. only levels 1-3 displayed on menu). However, if a student passes the quiz in level 3, level 4 automatically becomes available for play. Perhaps the most helpful option is ability to find out under which rule the program is operating for a given problem. The rules are number coded; the code of rules is included in the teacher's guide.

One of the most "interest catching" features of this program is the beautiful use of graphics. A different character guards the door of each level (room) of the castle. Crowns are won as the student meets the King (level 6) and solves his riddles. "The King's Rule" is a fascinating educational game.

Program Title: TRAP AND GUESS

Disc Title: Bumble Plot

Source: The Learning Company

Recommended Grade Level: 3-7

Reviewer: Sarah Leitner

A number line segment containing the numbers -3,-2,-1,0,1,2,3 is displayed either horizontally or vertically. The student is asked to select two numbers in order to trap the computer's number. [illegible] the guess is correct, the computer highlights the segment and prints, "(Name), you trapped my number." The student now has a choice of either typing two more numbers to make the trap smaller or trying to guess the secret number.

If the student's guess is incorrect, he is informed that the number wasn't trapped and he has the chance to try again. When the student guesses the computer's number, that number is printed on the screen in colorful graphics.

Students learn from this game that the position of the number line, whether horizontal or vertical, is not important to a number line. They learn that guessing is often a reasonable start to problem solving and they learn to use feedback to move from guess to logic. They learn that trapping a number is a human process--as is all of thinking--not a bunch of mechanical rules.

Program Title: BUMBLEBUG

Disc Title: Bumble Plot

Source: The Learning Company

Recommended Grade Level: 3-7

Reviewer: Sarah Leitner

A filled-in square on the grid represents the bug, and an open square represents the trap. The grid contains bottom and side numbers of -2,-1,0,1,2. The purpose of this game is to trap the bumblebug by putting the trap beside, but not on top of the bug. If the bumblebug hops in, the student has trapped it. If it hops away, the student needs to make another trap. To make a trap, the student chooses points which will be next to the bug. The student first types a number at the bottom of the screen, then types a side number. If the student is able to trap the bug, a smiling bumblebug is shown on the screen and part of a song is played.

Program Title: HIDDEN TREASURE

Disc Title: Bumble Plot

Source: The Learning Company

Recommended Grade Level: 3-7

Reviewer: Sarah Leitner

The object of this game is to locate the hidden treasures. A map appears on the screen with numbers from -5 to +5 and in two directions; left-right and up and down. The left-right direction is the X axis and the up and down direction is the Y axis.

The student selects a number pair for X and Y and is given hints to help him locate the position of the treasure, such as "Make the X the same and Y smaller." When the student has plotted the correct point on the screen, he has found the hidden treasure.

The treasures include items such as a diamond ring, an old boot, a silver goblet, and a rusty hook. When a treasure is found, a picture of it is recorded on the side of the screen, and after six items have been discovered, the boat carrying the treasures has become full. The student types "return" and the bumble takes the treasures to shore. The attractive graphics and music are great motivators in this game.

Program Title: SECRET NUMBERS

Disc Title: Numbers

Source: Lawrence Hall of Science

Reviewer: Sarah Leitner

The object of this game is to determine a secret number as quickly as possible. There are three variations of the game.

The first game starts with an empty box in which the computer begins writing a number. The student has to guess the number as quickly as possible. If the student's answer is correct, the computer displays many of the same number on the screen. If the student's guess is incorrect, the computer prints "Try again" and it automatically reveals a little more of the number.

The second variation begins with a box covered with squares and the computer randomly removes squares to reveal a number. When the screen is nearly cleared and the answer has not been guessed correctly, the computer clears all of the blocks to reveal the entire number. the student is asked to type in the correct number.

The third variation is similar to the second but this one allows the student to remove the blocks to reveal the number. Pressing the arrow keys uncovers a line of blocks in one direction. This game allows the student to pick the part of the number he wishes to uncover. This piece of software develops visual closure, hypothesis testing, and pattern recognition.

Program Title: NOTE SANDWICH

Disc Title: Music

Source: Lawrence Hall of Science

Recommended Grade Level: Pre-school - 1

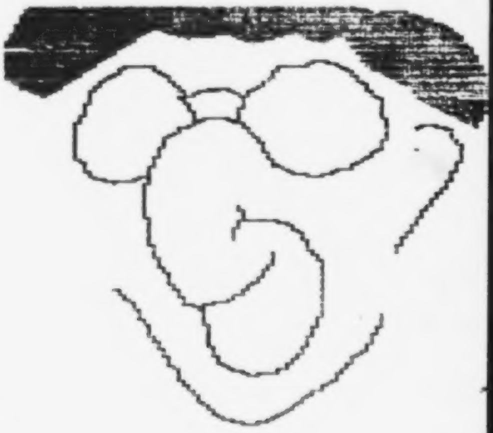
Reviewer: Sarah Leitner

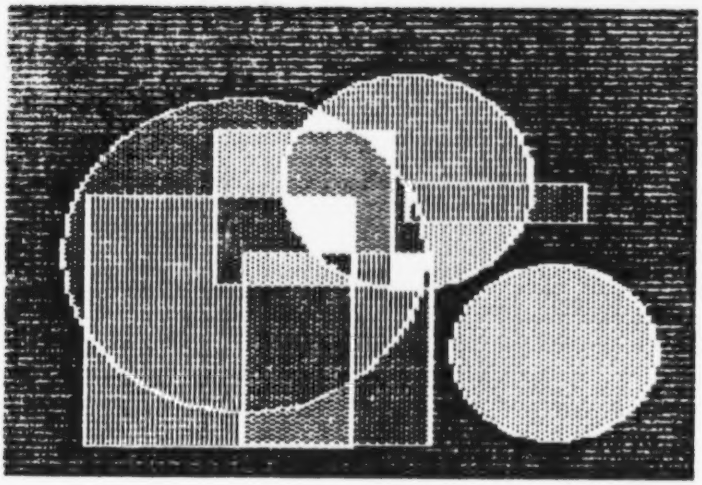
Students are introduced to the eight musical notes in a scale. Bars numbered one through eight represent the notes, and as the notes get higher, the length of the bars decreases. The student is able to hear each of the notes being played in the order of the scale.

Two of the eight notes are then played at random. The student is to try to guess a note in between the two notes. There may be several possibilities, and any note is correct as long as it is between the other two notes.

After the student has made a guess, he is able to hear the note and see its position on the scale. If correct, "You got it." is printed on the screen. If incorrect, the student has the choice of 1) hearing the entire scale over; 2) hearing the previous two notes; or 3) choosing a new number to change the guess.

I think that Note Sandwich is a very good program. It allows the student to control the amount of time needed to guess the notes, and it gives more positive reinforcement than negative reinforcement. Note Sandwich reinforces skills such as visual and auditory discrimination, listening and memory.





NEW RESPONSIBILITY NEEDED IN MATHEMATICS EDUCATION

Hassler Whitney

Teachers' Center readers are certainly familiar with Hassler Whitney, author of the widely used Part A (math activities for young children) and long-time friend and frequent visitor to the Teachers' Center Project. The present paper, reprinted with permission, appears as a letter to the editor in NOTICES of the American Mathematical Society, November 1984.

In the fifties and sixties,the "new math" was brought into being by mathematicians who knew the power and pleasure youngsters have in advanced mathematical thinking. Spreading first on the secondary level, it caused real problems on the elementary level; after a period of agony it was mostly rejected, to be replaced by a demand for "back to the basics." In the present time of pressure, we now see increasing calls for more, harder, and longer hours of study of mathematics for all students, starting earlier in life. Goals, underlying causes of difficulty, and side effects of actions taken are seemingly disregarded in the push to move ahead. The actual "learning" for most is at the lowest point of the century, while it could, with care and cooperation, be at its best. What I am writing here comes from intensive study of the problem since 1967, in classrooms and out, observing and taking part; a fuller account will be given elsewhere. Our help is sorely needed; I hope many of us will decide to dig deeper and strive for better schooling.

It is of course rote learning that is essentially useless. But we must look carefully at the attitudes and dynamics in the classroom to understand fully where the problems lie and what better methods can be used. Some examples will show up the problems.

We know that fractions cause lots of difficulty. Most of us may not realize that the teaching of "mixed numbers" goes on and on, with negative attitudes often outweighing any positive results. I first saw the struggles in a fifth grade class with the rules for doing 6 1/4 - 3 2/4 (the 2/4 clearly to make it easier) under a "master teacher" in 1967. So I asked Emily, in fourth grade and not yet taught, what 6 2/7 - 2 4/7 was. Her thoughts came easily. "Subtract 2/7, leaves 6; subtract another 2/7, leaves 5 5/7; subract 2, leaves 3 5/7." If you are not taught how, you can look at meanings and find the answer easily. This one remark will clear up the major problem, if we can only get it into practice.

Why the wrong attitudes? Preschoolers learn most admirably, with concepts far more subtle and complex than school mathematics, without being taught. Entering first grade, "Now I must learn the grown-up ways of thinking" becomes a powerful force. The great downfall begins generally with second grade 2-digit subtraction. The texts cut everything into "easy steps," so it is first taught "without borrowing." This trains the children to learn rules for working with digits, not to look at the numbers. Hence "borrowing" becomes contradictory (take the larger from the smaller?) and confusing; the attitude "each topic has its own rules" is creeping in solidly. (The behaviorists do not look at such side-effects.) Remedial work for masses of children starts here and may go on for years; they are finally likely to catch on through their own resources. Huge numbers of research studies aim at the sore spots, shifting the variables in teaching, rather than at the cure, dropping the teaching and letting the children explore and come alive.

Give a child (or better, a group) some play money, in ones, tens, hundreds, ... only; say three bills of $100 and four of $1. "Here is a nice picture, for $27; would you like to buy it?" On being offered $100, respond "Sorry, I don't have any change." This gives the responsibility to the child. With a sense of support, not suggestions, the child will look for a way to get change. Exchanging a $100 bill for ten $10's, exchanging $10 is still needed; then the purchase can be made. Repeating the experience, and letting the child record what was done, the algorithm appears (in the "most difficult case"). With further discussion, the algorithm is reduced to a simple form. Thus the natural order is: do, look-talk, understand concept, write, read; this is the opposite of the usual school procedure. And problem solving was done (not taught). Exploring situations you can see is far more successful than trying to learn abstract concepts.

Most teachers would gladly introduce such methods if they felt safe in the community. Often they start and gradually pull back. On the other hand, older professionals, researchers in particular, commonly do not believe such happenings are possible for most children; it is completely outside all their training and experience. It is highly important that we introduce such experiences on as wide a scale as possible, so they become thoroughly known. With some further rectifications of classroom style, the growth and power of the children can quickly become phenomenal, and all pressure to "cover the material" can disappear. (See "self-tests," later.)

Most of those who "got through" subtraction will be caught by long division; the complex of ever-changing rules is just too much.

Mathematicians generally recommend cutting it out since calculators can do the job. Yet by letting a group share money (similar to the subtraction experience), the algorithm again appears and the learning can be thorough and rapid. The important part is, of course, the ideas involved not the algorithm.

The National Council of Teachers of Mathematics is now emphasizing problem solving. This in itself will do little, for students mostly do not look at meanings. There is ample evidence of this from the National Assessment of Educational Progress; see (7). When 9-year olds with calculators were asked (exact form of the question unreleased) how many cars, each holding four children, are needed to transport 26 children, only 3% gave the right answer. (12% gave 6.5; 7% gave 65.) The professional conclusion is "they cannot solve problems with two or more steps." This should be changed to "they do not in a school situation" (see the reference to (3) below). Of course they would have no difficulty with this in real life.

To examine the situation more deeply we must ask what our goals are. Mathematics is important because of its many uses in increasing fields of work. Preschoolers already have a good understanding of small numbers; their continued growth in power of mathematical reasoning is the basic need. Along with this, in later life, taking responsibility for the results is essential, as are good language skills for communicating. So the essence of good schooling is the practice of these powers. This practice and growth is taking place when the student is keeping the situation being studied carefully in mind, going back to it constantly to check on the progess. If you stay with children in a classroom for a good period, sensing more and more just what their thoughts and attitudes are, you will see that almost never is this process taking place, even when the teacher is trying for it. Here is the precise point of failure of present day (and past) mathematics education (throughout most of the world).

We can now see better how straight teaching--presenting the material with explanations--misses the students. As they listen to you, if they did have a clear starting point (normally missing anyway), it is hard to get all your words and understand the argument, still keeping in mind where it came from. And if they do have all this in mind, then they could have done most of the reasoning themselves--why not let them carry through the reasoning? We are taking from them the crucial discoveries, just what is most useful and pleasurable, hence removing their responsibility also. We are not allowing their natural human powers to operate!

It is now looking strongly as though if we simply gave the children situations to explore, and let them discuss problems, then they would progress very well indeed. This actually has been done; see Benezet (2), referred to in (9) (in itself worth reading). In the late twenties Superintendent Benezet of Manchester, N.H. cut out all formal teaching of mathematics from the first two grades; there was all-around improvement, and the children caught up quickly in third grade. Then, in experimental classes, mostly in the immigrant district, he replaced formal mathematics teaching through grade five with free discussions on any topic, to promote reasoning and language skills. These children surpassed the upper class children in both language and (mathematical) problem-solving skills, and they caught up to them in formal mathematics the next year.

I do not suggest copying this. But letting the children have situations to explore, some leading to the usual algorithms, will without question produce beautiful results.

The considerations above are of course insufficient for introducing new programs into the schools. On the other hand, they show already why most of the projects up to the present have failed to get the children out of their attempts at rote learning. Until this is done on the elementary level, it will be quite difficult to make real headway on the secondary level. The latter requires a radical change of attitude by both teachers and students and will remain difficult as long as the curriculum stays as abstract as it is at present.

Some favorite types of teaching in recent years are the following. "Computer-assisted instruction" is used mostly to give drill; this promotes rote learning and does not help towards its use. "Individualized instruction" and "mastery learning" essentially govern the child's work through pretests and posttests; the child has "mastered" the topic when he has 75% or 80% correct. They don't worry about that 20% wrong; but worse than that, there is little personal contact with the children, and hence they can be hopelessly lost without anyone realizing it (see Erlwanger,(5)). There is a great push for finding and copying "efffective schools" now. The evaluation is mostly through standardized tests, and thus only the lowest level of learning is the main consideration; we cannot expect basically better things in this way. We need to broaden the "effectiveness." And the main effect of the great present call for technology is to use up funds badly needed elsewhere.

Here are some hints for quick learning. For numbers to 100, the children can make bead strings, colors changing after each ten, or after each five for shorter ones. Working in pairs, they can speedily learn all sorts of number facts, laying toothpicks between beads to show the numbers. Thus for the problem of 26 children, they can show groups of four and solve it at once. For larger numbers, colored popsicle sticks are ideal. (Use very concentrated food coloring; let plain = 1, red = 10, etc.)

Explore elementary algebra in many ways. For instance, how far is it from 18 to 40? (Answer is obvious on a bead string.) Looking at 40 - (20 - 2), you see the general fact $a - (b - c) = (a - b) + c$; it is now meaningful.

Real mastery and control of any topic is shown by self-tests. Let a student look at a hard problem, and say in advance if he or she can do it, being sure of the result. Then try it, with whatever time is needed; if the security is not there, he or she can see what needs to be done still. In this way you stop those endless lists of exercises which serve only as futile and bothersome busy work.

A most important part of mathematical and language skills is the use of quantities; yet in the texts, equations can be written in numbers only (denying the use of direct mathematical reasoning). "How fast do you walk?" is a fine way to start explorations. Let the students find ways to write results (3 mi/hr?) first; then help them to better ways. See that the equal sign can always mean "is." All quantities need description; thus $\underline{a}$ might mean an apple, a pound of apples, or the cost of either. With "in" and "ft" meaning lengths, ft = 12 in. is true, and either side can be replaced by the other anywhere; the difficulties with "units" disappear.

I recently had a shock, realizing how far better I could have carried out all my college and graduate teaching, when I asked an adult (with real math anxiety) how she might put numbers from one to a million on one line, showing enough numbers to get a feeling for differing sizes. She soon chose equal intervals from 1 to 10, then to 100, etc. In experimenting putting in further numbers, she found great squeezing needed as you go up. Then she chose a better place for 2 ahead of 1, and at once put 20 correspondingly ahead of 10. I then told her (response: "Oh, I can't do mathematics!") that she had discovered the exponential (power) function, and found its derivative, with a real sense of meanings, which college teachers wish their students could get. Will this be a helpful lesson to you too?

Teachers are in great need of help; but what really counts is their seeing models for getting the children exploring, and especially their having support for this from the community. Focusing on mathematical problems (see (4)) will help little here.

Educational research is a high art with careful, precise methods. But it treats students as objects, labeled through standardized tests, incapable of taking any initiative. The tragedy is that statements made are taken as authority on the highest levels. In the volume (3) from the National Academy of Sciences, p. 32, we read "A firm generalization arising from research on learning of skills is that acquiring significant competence in domains of any difficulty requires large amounts of guided practice--much more than is provided for most pupils in schools or most adults who try to prepare for new technical jobs." It is important that we counter it!

The two national commissions of 1983 (see (8)) were carried away by such ideas. "Require that students take more mathematics" (even if they fail?). "Mandate longer school hours and years." "Start teaching earlier." And the states are moving in these directions.

In Minneapolis 11% of kindergartners recently failed their tests and must take remedial work (contrast with (1) and (2)). The whole picture, to me, shows a lack of responsibility.

Our top priority must be with the students. In high school they are mostly half alive (6). With their rampant math anxiety they have come to believe in their labels of incapability; the usual remedial work makes no dent in this. Will we give them honest help?

We have begun to stand up (with help from industry) for our proper place in society. Along with this, we must help show the disaster in schooling and get the focus onto the basic causes and cures. But we must also see how to act effectively. To be listened to, we must first approach and listen; our accepting some reality in views of others enables them to accept as possible our own views. We can then all work in a more cooperative spirit towards a better future for what counts most of all, our children.

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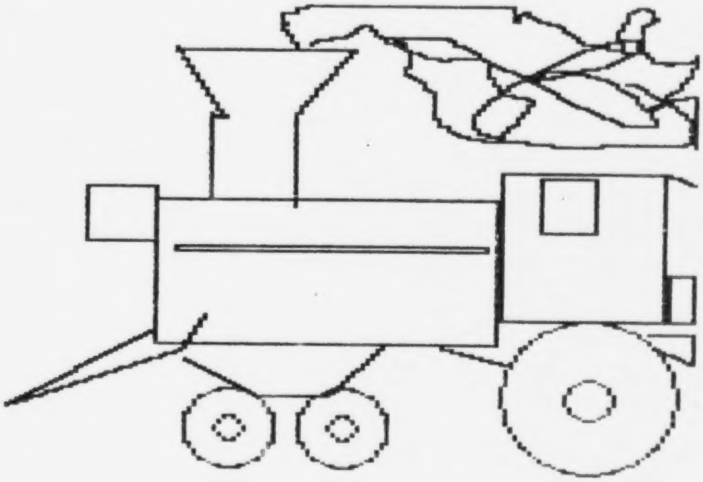

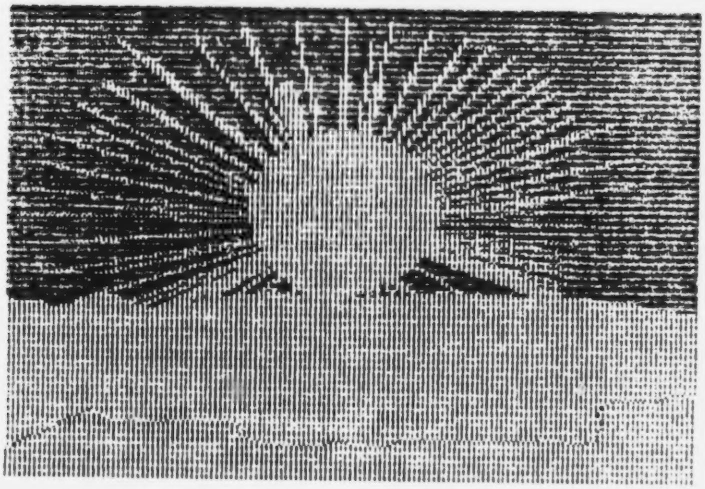

CLASSROOM ENQUIRY: AN APPROACH TO UNDERSTANDING CHILDREN

Stephen Rowland

Stephen Rowland, Leicester Educational Authority, presented this paper at the annual meeting of the Association of Teachers of Mathematics in London in April of 1984. It's closely related to his "Enquiring Classroom," a report on a year's childwatching in a Leicestershire school, published by The Falmer Press (represented in the US by Taylor and Francis, Philadelphia). Says Rowland, "The process of teaching and learning is two-way. It involves not only the child's attempt to interpret and assimilate the knowledge and skills offered by the teacher's attempt to understand the child's growing understandings of the world."

In this paper I want to explore the concept of "Classroom Enquiry" as an approach to the relationship between learning, teaching and understanding children. While the ideas I shall present are to a large extent personal, they do, I believe, form the basis to much of the work that has been done in the Leicestershire Insights Into Learning project.

The argument I want to develop is premised upon two fundamental viewpoints, one concerning children and childhood, the other concerning the nature of knowledge. It is difficult to see how either viewpoint could be proved, although I think they can be clarified and demonstrated by a close study of what children do.

CHILDREN AND KNOWLEDGE

First then, concerning children. Children's work is worth taking seriously, not merely as reflecting the fits and starts towards some ultimate goal of adulthood, but as a contribution in its own right. The limitations in children's experience of the world, and in the knowledge and skills that derive from that experience, are obvious. However, within the limitations of that experience, we can see children as thinkers, as having ideas they want to explore and express and as having purposes and intentions which underlay their activity.

In these respects they are no different from adults. It follows from this that their activity and expression can be interpreted not only as evidence that they have reached a certain "stage of development" or "level of understanding," nor only as evidence that they have more or less understood an idea that we have intended to put across to them. Their activity can also be interpreted as representing or expressing an understanding of the world which can be of significance to us. It takes a considerable effort of the imagination to empathize with young children sufficiently to begin to understand their perspective on the world as expressed by their activity in the classroom. But reconsider our own understanding. I am reminded here of how my understanding of the concept (Is it a concept?) of subtractions was radically developed by considering how, from a group of seven-year-olds, seven different strategies emerged for finding the difference between pairs of numbers all less than ten. "Subtractions" was a more diverse and complex notion than I had initially thought. My claim here is not that these children's understanding of subtraction was greater than mine, but that their insight and their activity was sufficient to provoke me into reconsidering what I understood subtraction to be.

Children, then, present us with a twofold challenge: to understand how they understand the subject matter, and to review our own understanding of it. Unless we are prepared to learn from children and with children, I think it unlikely that we will learn much of significance about them.

My second fundamental viewpoint concerns the nature of knowledge. As a teacher of young children, I can claim to have, or to have access to, more knowledge in most fields (though by no means in all) than the children I teach. It therefore seems reasonable to suppose that my duty is to pass on my knowledge to the children. Surely that is what teaching is all about? But there is a danger here of misunderstanding the relationship between knowledge and experience. Knowledge is rooted in experience. Therefore to "pass on" knowledge requires me to "pass on" experience. Clearly, there is a sense in which we can "pass on" experience; we can represent our experience in language or art, we can reflect with others on their experience drawing parallels from our own, or we can construct learning situations which we believe might produce appropriate experience. But our experience itself cannot be passed on. It has to be interpreted by us, reinterpreted by others, and related to their experience, before they can make use of it. For this reason, any knowledge which children gain from our experience must be a reconstruction of the knowledge which we gained from that experience. How different the children's reconstructed knowledge will be from our own knowledge will depend upon the differences in our personal histories and the differences in our cultural and linguistic backgrounds. To underestimate or ignore these differences may result either in complete failure of children to reconstruct anything of value from our experience, or an unjustified imposition of our culture upon them.

There is a further problem with the notion that knowledge can be passed on. This concerns the structure of knowledge. The prevailing influence in modern industrial and technological society has been the view that true knowledge--scientific knowledge--is analyzable into component "bits" which can be taken apart and assembled rather like the component parts of a clock. This mechanistic view of knowledge, whose origins we can trace back to the influence of Newton and Descartes, has led to the fragmentation of academic disciplines and to the supremacy of so-called scientific knowledge over awareness, aesthetic and other forms of knowledge. In the classroom, this view of knowledge has reached behavioral objectives and rigidly structured syllabi.

However, since early in this century, physicists have seriously begun to question this mechanical model as an appropriate tool for understanding the world. In many areas of investigation it has become increasingly apparent that aspects of complex phenomena cannot best be understood by simply reducing them to their constituent parts. An important trend amongst much of the scientific community--though perhaps not yet amongst educationalists--is towards a more holistic view of knowledge, that is, an understanding of reality in terms of integrated wholes whose properties cannot be reduced to those of smaller units. The implication of such a change in approach for the classroom is that we cannot best understand children's learning as following a linear sequence as more "bits" of knowledge are added, but must instead view the growth of their knowledge in relation to their wider experience, from which it gains its meaning.

This more holistic approach to knowledge clearly leads one to view the "learning package" with some skepticism, to be less certain in one's ability to predict what learning will result from which experience, and so places a greater obligation upon us, as teachers, to try to understand the understanding of children as it develops in the classroom.

To summarize, then, the position I have sketched out with regard to children and knowledge: children's learning activity is worth taking seriously as an active and purposeful expression of significant ideas, rather than as a passive response to the situation. The knowledge they gain from that activity is a construction from their experience of it, or a reconstruction from the experience of others. It is not merely a replication of knowledge that exists outside them. Such knowledge is best viewed as being integrated into their wider understanding, from which its meaning derives. It is not separable into all its constituent elements which can be learnt and viewed independently, only to be assembled and thereby given meaning at some later stage.

TEACHING--AN INTERPRETATIVE APPROACH

The implications of these ideas for us, as teachers, are apparent. Since we cannot accurately predict what knowledge will be gained from a particular experience, nor can we assume that it will be gained according to a prespecified sequence, we must be concerned in our interactions with the children and their work, continually to interpret how they understand the subject matter. Of course, any thoughtful teacher attempts to do this anyway. But what I am suggesting here is a shift in emphasis. As we talk and work with children, the central question in our minds should not be "Has the child understood what I'm getting at?" but "Have I understood what the child means?" It is our answer to that question which guides our contribution to the learning that is taking place between us and the child.

It might be said that the art of good conversation rests largely in each party's ability to empathize with the other, that is, their willingness to attempt to see the question from the other's viewpoint, even if only so that this viewpoint may be challenged more effectively. Such conversation provides an appropriate model upon which to base our interactions with children. Its success demands and promotes an expanded awareness on both sides of the teacher-learner relationship, a relationship from which both parties learn and to which both contribute their significant experience. It also assumes a sense of equality in that the meaning and purpose of any learning interaction is not defined solely by the teacher, but emerges from the attempts of both parties as they seek to understand each other, and to understand the subject matter which lies beyond them both.

Such an approach to teaching does not rule out the role that direct instruction might play in the classroom. On the contrary, it provides a context in which we are more readily able to judge the appropriate content and methods for instruction so that use can be made of it by the child. The failure of many instructional packages and programs lies not in their being instructional, but in their being designed with little regard to the concerns and wider knowledge of the learner. Their use then produces, at best, a kind of knowledge which is alienated from life outside the schoolroom, which may lead to success in the narrowest of examinations in the short term, but a general disillusionment with the educational process in the longer term.

Nor does this approach envisage the rejection of educational objectives. They are vital if we are to provide for and stimulate the children across a wide range of experience. However, when it comes to evaluating what learning has taken place, it is important not to restrict our interpretation of the children's activity by the objectives we had in mind. Our objectives, which inform our plans, comprise our prior hopes and expectations as to where the children's activity might take them. Without them, we would not have a starting point for understanding their activity. But too narrow a focus on our objectives can prevent us from seeing what it is that concerns the child. In such cases, our further contribution to their activity will be misinformed. Thus our objectives, while providing a frame for planning and interpreting what takes place in the classroom, should always be viewed as provisional, as providing a perspective from which we are always ready to take a sideways step in order to engage with the child.

CLASSROOM ENQUIRY AS A WAY TO UNDERSTANDING LEARNING

Throughout these comments I have referred to the need to be continually interpreting children's activity--their actions, their language, their writing, and so forth. However, given the real classroom situation, with thirty or more children often engaged in a wide variety of activities, and only one teacher, much of our interpretation is done very rapidly and on the spur of the moment. The speed with which we have to make decisions on our feet often allows little time for cool reflection. For this reason, the interpretations we make in the classroom are likely to be based upon rules of thumb and everyday assumptions which we use uncritically about the children and the subject matter. A more careful investigation of what children's activity really means, requires not only time, but a certain "intellectual space"--an opportunity to reflect, preferably with others, and develop and share insights into the children's concerns, skills, and understandings. Certainly, we cannot reflect with this degree of intensity upon all the children's work, nor even upon a major proportion of it. Nevertheless, the in-depth study of selected samples of activity from our classrooms can lead us to challenge, modify, and at times radically to alter, those assumptions from which we work when we interact with children in the classroom. It can help us build an understanding of the learning process and of the concerns of children which are expressed and developed through that process. Such understanding must be developed by us if we are to realize our role as educators rather than merely as purveyors of knowledge.

It is this attempt to study in depth, or analyze, selected samples of children's activity and work from the classroom that I would call Classroom Enquiry. I use the term "Enquiry," rather than "Research," because it differs from normal academic research in several fundamental respects. It takes as the starting point of its investigation our experience of the children and their activity. This experience is necessarily subjective. It is quite obvious that any two observers--and especially any two teachers--presented with the same classroom event will perceive different things. For example, a piece of writing that strikes one teacher as showing a poor grasp of grammatical conventions, for another may be evidence of ingenuity in self-expression.

This essentially subjective way in which we interpret children's activity has been considered by many educational researchers to be something to be avoided at all costs. "Unreliable" accounts of teachers are dismissed in favor of such devices as observation schedules listing categories of behavior to be noted and ticked off at regular intervals, and questionnaires and tests whose results can be readily subjected to statistical analysis. Such attempts to gain understanding again reflect a view that knowledge about the world--our knowledge about the children as well as their knowledge--can be mechanically broken down, or reduced, into "bits" without regard to the subjective experience of the observer or the observed.

On the contrary, explanations of the learning process itself must be concerned with the children's intentions, their interpretations and the thinking they bring to bear upon their activities. It is these non-behavioral aspects of classroom life which we must gain access to. This cannot be achieved by an observer who is separated from the children both physically and psychologically by the research tools used to measure behavior. Through teaching, however, with our close involvement with children and our professional skills which are intended to enhance our understanding of them, we are in a privileged position. The inner thoughts and intentions of children will never be quite open to us as we shall always have to speculate. But we are nevertheless in a position to relate closely to children, to prompt their thinking and thereby to begin to reveal it.

Our own writing plays an important part in this process of revealing the children's understanding, of sorting out our ideas about it. One can only get so far by thinking alone. With children's writing in mind, Bruner described writing as a "calculus of thought for ill-formed problems--problems, that is, without unique solutions." For the enquiring teacher writing is not so much a means of recording data--although it certainly has that function--or even of communicating ideas, as an important part of the process of reaching closer understanding; understandings which are always provisional and are the subject of further reflection.

However, once we accept that it is our subjective experience and reflections upon that experience that provides the richest material for our enquiry, there are serious difficulties we have to meet. How sure can we be that our interpretations of the children's activity will not merely reflect our prejudices, our personal framework of values? Will not the understanding we thereby gain serve to confirm our position rather than challenge it?

In order to meet these difficulties we have to think carefully about how we can share our descriptions and interpretations of classroom activity with each other. Whereas, conventional research seeks to minimize the subjectivity of the observer and make generalizations from as wide a sample as possible, classroom enquiry capitalizes upon the different viewpoints of teachers in order to evolve deeper understandings of the particular. We therefore have to construct opportunities in which we can explore these different perspectives. Our classroom enquiry, then, is not only an individual's reflective analysis of what has taken place, but must invite the reflections of others. It goes without saying that this sharing of ideas must be critical, that is, must welcome the expression of contrary viewpoints in an atmosphere that is secure enough for individuals to reason with and reject each other's ideas. The results of such open sharing of our understandings of children's activity will not result in generalized and objective truths about how children learn. To search for that would be a hopeless enterprise. Rather, it aims to produce intersubjective understanding of the complexities of the learning mind and a more articulate language with which to share such understanding. It is arguably the case that the difficulties we have in understanding how children's minds, and indeed our own minds, grow is not so much the result of a failure to establish the "true facts" about learning as a failure to develop a language and conceptual framework for interpreting and communicating our experience of learning.

It is our task, through classroom enquiry, rather than the task of the professional researcher, to develop this framework. Traditionally, the functions of production and consumption of educational research have been separated by the institutitons of research and schooling. Academic research has produced "findings." Teachers have been encouraged to make use of their findings. That we have largely failed to do so reflects·not only the difficulties we have in finding the time to interpret research that is often written in a language that is inaccessible to many of us. Nor does it reflect an inevitable opposition to the conclusions which such research has reached. Rather, it is based upon our conviction that it is the teachers' and children's experience of the classroom which is authentic, their reflections upon it which are most significant, and that it is in these that our understanding of children in the classroom will be rooted. But that understanding will not develop by itself. It requires our concerted effort to make opportunities to share our experience, reflect upon it and thereby make it more articulate.

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CHILDREN'S IDEAS ABOUT WRITTEN NUMBER

Mieko Kamii

As is well known by readers, Piagetian research has been largely concerned with the evolution of children's knowledge of such basic organizing principles as number, space, time, probability, causality and the like. Until recently, nothing has been done with respect to the child's concept of printed material, a major intellectual issue and a pertinent issue for educators given that the curriculum is so print-dominated.

We are happy to reprint, with permission, a paper by Mieko Kamii written as an off-shoot of her doctoral work at the Graduate School of Education, Harvard University, which discusses the child's concept of numeration in the tradition of old Teachers' Center friends Hermina deZwart Sinclair (Geneva) and Emilia Ferreiro (Mexico City). Dr. Kamii is on staff at Wheelock College, Boston.

For the last few years, I've been intrigued by children's difficulties with number, and the relations between these difficulties and children's problems in understanding our notational system. From the adult's point of view, our numeration system is an elegant and commodious tool. It is a base 10 system that uses ten digits (0 through 9) and the notational principle of position or place value; the position or place in which a digit is written indicates the numerical value of that digit. Each position to the left and to the right of the decimal point is assigned a specific numerical value (power of ten). Thus the notational principle of position, coupled with the numerical idea of power, allows us to write any number, no matter how large or how small, with only ten digits. Furthermore, computations in this system are eminently sensible and easy to perform. In comparison with cumbersome procedures such as the method of "doublings" employed in medieval times, the modern algorithms make the arithmetic operations (addition, subtraction, multiplication, and division) accessible to almost everyone.

Why, then, do children experience so many difficulties with numbers? Are there discernible relationships between these difficulties and the notational system? Some math educators think that there are. For example, Easely and his associates have noted that at least half of the children in second- through fourth-grade classes are making serious computational mistakes, which suggests that they do not understand place value. The problem crops up the moment children can no longer handle addition by "counting on" and subtraction by "counting back" and therefore need to learn regrouping (Easely, 1980; Stake, 1980). Carpenter and his colleagues focused on an older population in analyzing the results of exercises involving decimal fractions on a national math assessment. They found the conceptual understanding of decimal fractions of roughly half of the nation's 13-year-olds to be inadequate and related this finding to place value comprehension problems. Many areas of difficulty for the 13-year-olds were problematic for the 17-year-olds as well (Carpenter, Corbitt, Kepner, Lindquist, and Reys, 1981).

The Piagetian Perspective

From the Piagetian point of view, notational systems are cultural objects: they are composed of arbitrary graphic marks or "squiggles" that are organized into systems whose rules are social conventions that must be learned (Sinclair, 1980). Every squiggle-system has properties of its own. To record number, for example, we use the number-squiggles 0 through 9; these digits are organized into a numeration system with base 10 and place value. To record spoken language, by contrast, most Indo-European languages, including English, use an alphabetic writing system. Among these languages the translation of spoken into written language rests on the phoneme-grapheme or sound-squiggle correspondence. This principle, that the graphic marks reproduce the sounds of the spoken word, is alien to written number.

In short, digits and numerals, and alphabetic letters and words, can all be thought of as socially constituted objects of the external world (Ferreiro, 1979). They are objects which can be thought about, and many children do have ideas about them well before they enter school (Ferreiro and Teberobsky, 1979).

The meanings which preschool children attribute to the squiggles are sometimes surprising. F. Siegrist, A. Sinclair, and I. Berthoud (research in progress) interviewed a child of 4:1 who, when shown pictures of objects with numerals on them, thought that a 4 on a birthday cake meant "cake" and the numeral 15 on the door meant "door," as if the squiggles were the names of the respective objects. Another child of about the same age (4:2) thought that the 4 on the cake meant "it's good to eat" and 15 on the door said "to recognize my house." For the latter child, the squiggles carried some kind of a functional message. Siegrist, A. Sinclair and Berthoud find that children think the numerals are linked with the objects on which they are found, but that the types of linkages, or meanings, take very different forms: naming labels which are redundant in that they give no new information, and functional messages which serve such purposes as telling what the object is good for, or giving instructions or orders, in much the same way as highway speed-limit signs convey to adults how fast they are allowed to drive. In the case of functional messages, the meanings of the number-squiggles depend in part on the nature of the objects on which they appear, or the frame of reference to which the object is assimilated. The latter phenomenon appears in adult functioning all the time: who would mistake "12.95" (the price of a book) with "1981" (its publication date) or with that long string of numbers (its Library of Congress designation) even though all of them are written with the same set of digits? As adults we have learned to recognize that certain socially determined constellations of digits have different kinds of meaning.

From the standpoint of the historical development of knowledge, the story of our numeration system is a long and indirect tale. Systems other than our own have been developed to record number and to perform calculations (e.g., cuneiforms of the Babylonians, ideographs of the Chinese, alphabetic letters of the Phoenicians and Greeks, among others). Changes within each of these systems, when they occurred, seem to have come about from contact between cultures rather than from indigenous or internal developments; they seem to have resulted from one culture incorporating elements of another culture's notation system into its own, rather than from spontaneous modifications of the system from within. Often two systems were used side by side, in different specialized contexts. A contemporary example of this juxtaposition of systems may be found in measurement: the metric system, adapted from continental Europe, is widely used in scientific contexts and even taught to school children from use in that context. But cooking still uses teaspoons and cups; real estate employs square footage and acreage; and farming relies on bushels and bales.

From the vantage point of the development of knowledge in the individual, often it is the conflict or clash among ideas about number that motivates the individual to make choices or reconcile differences between competing ideas. These actions enable the individual to construct more adequate levels of conceptualization.

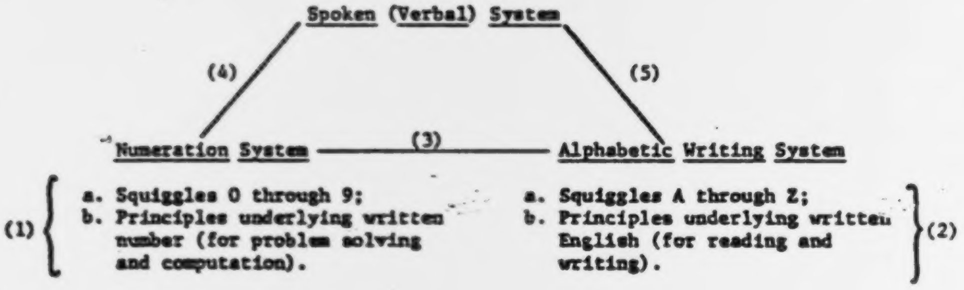
This is the sense in which, as Piaget argued, each child reconstructs knowledge for himself. By focusing on areas of conflict, we may be able to expose the sources of difficulty that adult knowers face, and child learners encounter, in grappling with the numeration system.

Areas of Conflict in Written Number

Three groups of conflict become evident from an empirical analysis of children's ideas about written number. The first group concerns clashes between spoken and written systems of representation; the second centers on conflicts between the principles underlying number and the principles governing written number; and the third focuses on differences between the ideas underlying arithmetic operations and mechanisms for written computations.

Conflicts Between Spoken and Written Systems

It has been argued that both the alphabetic and the numeration systems are objects of knowledge. In this perspective, it is the task of the child to figure out not only the principles which underlie each of them as separate systems (that is, their internal consistencies and inconsistencies) but also the similarities and differences between spoken and written number on the one hand, and spoken and written English on the other. (These relations are summarized in Figure 1).


Spoken (Verbal) System
(4)
(5)
Numeration System
(3)
Alphabetic Writing System
(1)
a. Squiggles 0 through 9;
b. Principles underlying written number (for problem solving and computation).
a. Squiggles A through Z;
b. Principles underlying written English (for reading and writing).
(2)

(1) Numeration system (written number);
(2) Alphabetic system (written English);
(3) Similarities and differences between written systems (numeration, alphabetic);
(4) Correspondences (and exceptions) between spoken and written number;
(5) Correspondences (and exceptions) between spoken and written English.

Figure 1. Relations within and among notational and spoken (English) systems.

Most children are dreadfully confused about how to write a number such as 14 or 16. With the miserable "teen" numbers, the sound/squiggle correspondence is completely inverted: sixteen is written 1-6 from left-to-right, and not 6-1, even though the six is heard first. For the child who is also learning the alphabetic sound/squiggle correspondence in order to read, the notation for the "teen" counting words has to be mysterious. Another instance of the clash between the spoken and written systems can be seen when children write a number such as one hundred and twenty "10020"--first one hundred, and then twenty, as if one were "spelling" numbers.

Children are introduced to both the numeration system and the alphabetic writing system at the same point (roughly ages four, five and six), and they often act as if the verbal, alphabetic, and numerical systems were more mutually consistent than they are. The tendency of the child who is trying to learn the rules of cultural systems is to presume that the priciples underlying each of these different systems--verbal/numeration, verbal/alphabetic, and numeration/alphabetic--are more coherent than they are.

Conflicts Between Number and Written Number

The second group of conflicts which the child has to deal with concerns the principles underlying number, and the principles underlying the notational system for recording number. A knowledge of the numeration system is quite separate from a knowledge of number. A child of five or six who has just recently conserved number has finally come to the important realization that the numerical quantity of a collection of objects (its numerosity, its cardinal value, its number) is completely unaffected by either the spatial arrangement of the objects, or the temporal order in which the objects are counted. So long as the child imposes some kind of order on the objects and counts each object once and only once, the number remains the same.

But the notational system employs principles that sharply clash with these fundamental properties of number. The spatial arrangement of the digits, and the left-right order in which multi-digit numerals are written, does make a difference in the quantities they represent (see Figure 2). For the child who has only recently conserved number, and thus learned that the order and the spacing of the objects does not matter, being then told that the order and spacing of the written numbers representing those objects does matter must be a bit bewildered.

Spatial Arrangement	Order
1 2 5 "one" "two" "five"	215 and 251
12 5 "twelve" "five"	521 and 512
1 25 "one" "twenty-five"	152 and 125
125 "one hundred twenty-five"	

Figure 2. The spatial arrangement of the digits, as well as the order in which the digits are written, affects the numerical quantities they convey.

Conflicts Between Arithmetic Operations and Written Computations

Not only do the principles underlying number and written number clash, but the principles underlying the arithmetic operations and written computations can clash as well. Multiplication provides us with an example of this clash (see Figure 3). In the first example of 3 x 4 (e.g., three pieces of candy on each of four plates), multiplication is the action of repeated addition, that is, adding groups of three discrete units four times. The notation uses a multiplier, 4, which represents the number of times that the action of addition (+3) has to be repeated. The result is twelve discrete units. The difference between addition (3 + 3 + 3 + 3) = 12 and multiplication (3 x 4) = 12 is that multiplication is an operation on an operation, or a second order operation: the new term, the multiplier, represents an operation (number of times) on an operaion (addition of +3). The result (12 pieces of candy) is the same in both cases.

But Easely (1981) points out that multiplication is more wondrous than this analysis suggests, for the operation of multiplication seemingly enables one to create new entities, such as area or volume, out of other entities, such as line segments. Multiplication, in other words, can appear to be something more than repeated addition. In the second example (Figure 3), a horizontal line segment of 3 inches (a piece of chalk 3" long) is moved vertically down (a blackboard) a distance of 4 inches, thus creating a new entity which is no longer a line segment, but rather a "smear." Out of an operation on two line segments of 3 inches and 4 inches, a new entity is generated, and that is an area which is 12 square inches. The computational form and the written representation in this case are the same as in the example of the candy, nonetheless. A child who has been taught to think of multiplication as repeated operations of addition might be justly perplexed about how to conceive the chalk smear as "repeated additions."

Notation for the actions (operations) in both of the following examples:

$3 \times 4 = 12$ or $\begin{array}{r} 3 \\ \underline{\times\ 4} \\ 12 \end{array}$

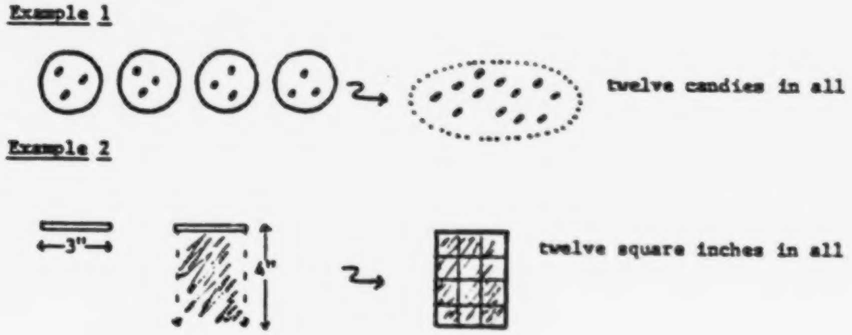


Figure 3. Multiplication as simply repeated addition (Example 1), vs. multiplication as creating new entities (Example 2).

The Development of Knowledge of the Numeration System

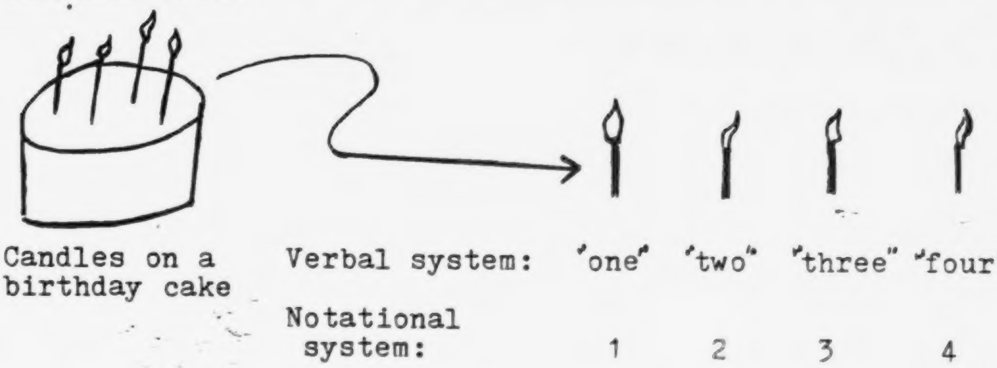
It seems to me that we will come to understand children's confusion with our numeration system only if we recognize that a child's knowledge of the principles underlying that system develops coincident with, and through (a sometimes confused) interaction with, his knowledge about number and about computational procedures. From this point of view, the developmental course of knowledge-building about the notational system can best be understood by looking at the variety of hypotheses which children are bringing to bear on the meaning and uses of number-squiggles. Two of the earliest meanings that children ascribe to the squiggles have been discussed: that they state the names of the objects (so that 4 on a birthday cake means "cake"), and that they convey functional messages (so that 4 on a birthday cake means "it's good to eat"). Both of these are non-quantitative meanings.

Somewhat later, the correspondence between numerals and objects changes for the child. Figure 4 shows an example of a child who has gotten the idea that each object in a sequence of objects receives an independent number word and squiggle: "I am four years old, one, two, three, four." The link between numerals and objects is similar to one the children have made earlier between objects and number words: point to the first object, say the first number word; point to the next object, say the next number word; and so forth. But a crucial difference has now developed; where before all cakes would presumably be tagged with a numeral 4 (meaning "cake" or "good to eat"), now the child tags each cake with a different number.

Adult: How old are you?
Child: I am four years old, one, two, three, four.
A: Can you show me the four?

C: Points to the last object in the series (four candles).
A: Can you write something to show how old you are?
C: Either makes some marks on the paper (child's symbolization), or adult writes the numerals 1, 2, 3, 4 (conventional notation).
A: Does one of these show how old you are?
C: May point to the digit, 4, which is simultaneously (a) the squiggle that corresponds to the last word, (b) the last squiggle written, (c) the squiggle that corresponds to the fourth candle, and (d) the single squiggle that has the possibility of representing the whole.

Figure 4. One-to-one correspondence between objects, counting words, and number-squiggles. Note the clash between the "ordinal label" or positional idea and the idea of cardinal value.


Candles on a birthday cake
Verbal system:
"one"
"two"
"three"
"four"
Notational system:
1
2
3
4

We could call this notion "the ordinal-label idea of numerals" because children who engage in this behavior now seem to know that each object in a sequence of objects receives an independent squiggle or number word. The graphic squiggles are used to show the position or location of a specific object in the sequence of similar objects. However, the idea that the last label given out, e.g., "four" in the verbal system and 4 in the notational system, can also represent cardinal value, or the numerosity of the whole, is still missing here. True ordinal number, for which this behavior may be a precursor, answers the question "which one"--in other words, location or position--and cardinal number answers the question "how many." Numbers, of course, are both cardinal and ordinal.

In research with first-through sixth-graders (presently being conducted with the assistance of Richard Carter of MIT), we have found children as old as eleven whose behavior reflects this clash between the ordinal-label idea of numerals (i.e., one-to-one correspondence between numerals and objects) and the cardinality idea of numerals. We have asked children, who come from a mixture of socioeconomic backgrounds, to make drawings of simple objects of varying amounts (n = 16, n = 20, n = 34), and then to show, with numbers, how many he or she had drawn in all. Most children of seven or eight years of age and older write a numeral which corresponds to the drawn amount. However some children (up to eleven years old and in the sixth grade) have written the entire sequence of numerals either on, below, or above the drawn objects (see also Sastre and Moreno, 1976). When asked to show if the double-digit numeral has anything to do with the drawn objects, most children indicate that it stands for the whole amount. But some children have pointed to the last object, as well as all sixteen objects, for the whole numeral 16 . When asked about the left-hand side of the numeral 1 6, they indicate the first object drawn; the right-hand side of 1 6 is interpreted as meaning the sixth object pictured. This behavior shows that here is a clash, in the mind of the child, between the idea that numbers can signify position in a series and a whole amount.

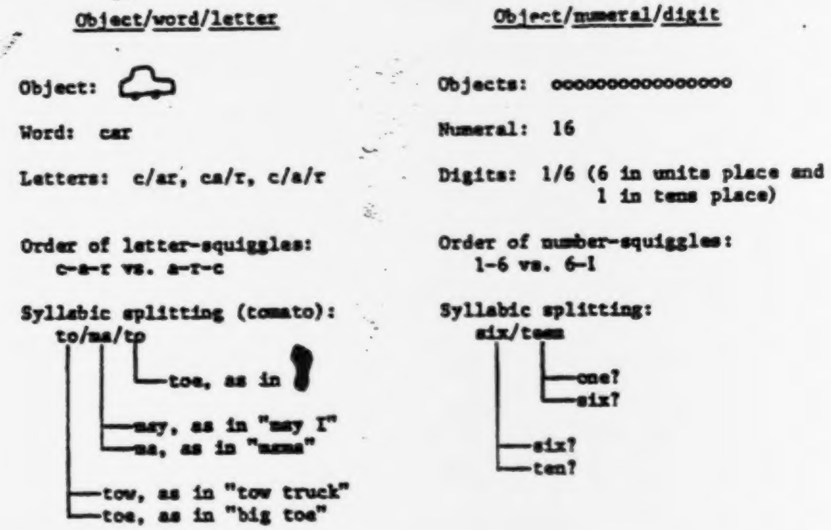

Object/word/letter
Object:
Word: car
Letters: c/ar, ca/r, c/a/r
Order of letter-squiggles: c-a-r vs. a-r-c
Syllabic splitting (tomato): to/ma/to
toe, as in
may, as in "may I"
ma, as in "mama"
tow, as in "tow truck"
toe, as in "big toe"
Object/numeral/digit
Objects: oooooooooooooooo
Numeral: 16
Digits: 1/6 (6 in units place and 1 in tens place)
Order of number-squiggles: 1-6 vs. 6-1
Syllabic splitting: six/teen
one?
six?
six?
ten?

Figure 5. Words and numerals which are indivisible wholes seem to vanish when they are split up into their constituent notational parts or spoken syllables.

This kind of behavior, which is typical of ages five and six with smaller numerosities (that is, the reproduction of the entire sequence of numerals in response to the question, "how many in all") brings into relief Piaget's idea that both ordinal and cardinal number develop at the same time. Our research suggests that although children may have both ideas, they have not necessarily integrated them.

Yet another hypothesis that young children have, is the idea that the digits forming a multi-digit numeral are "glued together" in much the same way as the alphabetic letters which make up a word are "glued together." This ideas clashes with the notational principle of position, or the place value idea. In Figure 5, the child has the notion that a whole collection of sixteen objects are represented with a 1 and a 6 which are "glued together" in an indivisible whole, just as the word for the thing on four wheels that one drives , written c-a-r, is an indivisible whole. In this view, the meaning of sixteen disappears when the numeral is split into its constituent digits, that is a 1 in the tens place and a 6 in the units place, just as the word "car" vanishes when it is split into its alphabetic elements--c/ar, ca/r, or c/a/r.

Children know at least by the end of the first grade that "16" is different from "61," or that the order in which the elements are written has something to do with the magnitude expressed, just as the letters a, c and r convey a different sound (and a different meaning) when they are written in the order c-a-r rather than a-r-c (whose meaning they may not know, but at least whose sound is familiar--ark, as in "Noah's ark"). For a child who has learned that the sound-squiggles to-ma-to mean a round, red, eatable when put together, but something that has nothing to do with eatables when taken apart (toe or tow, may or ma), it must be quite confusing to be told that one can separate out the manipulate parts of number-squiggles and still be referring to the whole thing (de Bellefroid and Ferreiro, 1979).

A different hypothesis is found among children who will grant that a multi-digit numeral such as 34 or 123 can indeed be taken apart. Children believe that when the digits of a multi-digit numeral are separated, the individual digits (e.g. 3 4, 3 4 in 34) represent individualized numerals which, in turn, stand for the quantities signified by those numerals. The separate digits of a multi-digit numeral have the same meaning as when they stand alone as numerals in their own right. Because the numerical meaning of number-squiggles and the positional or notational meaning of number-squiggles clash, children resolve this dilemma by making a number out of each digit (see Figure 6). In fact, there seems to be a developmental progression from the idea that the marks are an indivisible whole, that "glued together" they correspond to the cardinality of the collection, to the belief that when the multi-digit numeral is split into its constituent parts, the digits themselves form distinct numerals.

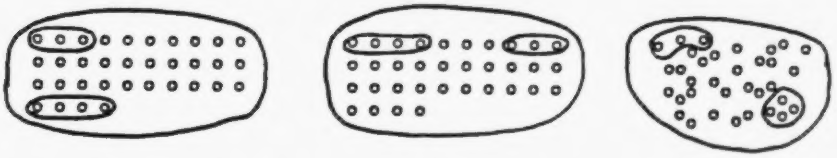
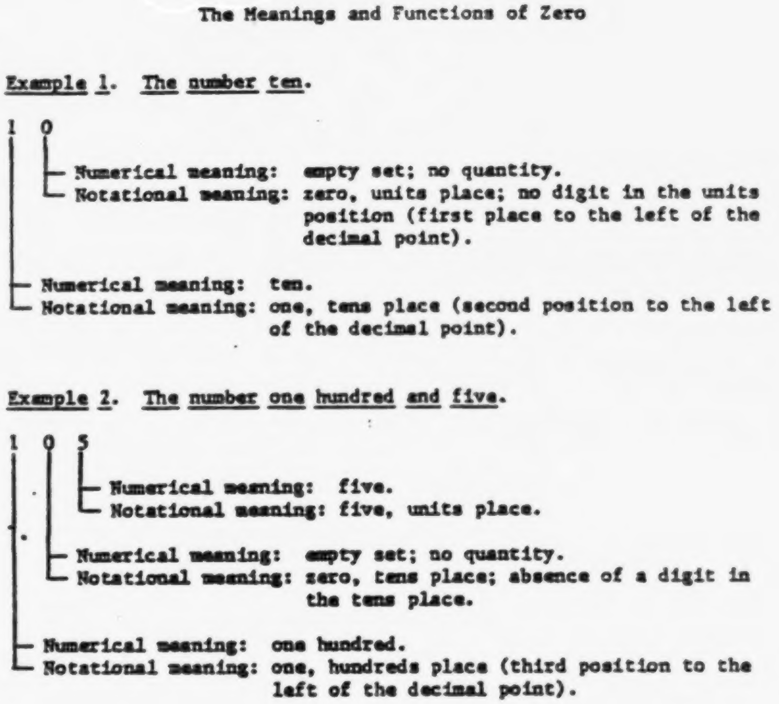


Figure 6. Each digit of a multi-digit numeral is transformed into a numeral, regardless of its position. Thus the 3 in 34 is interpreted as meaning "three" and the 4 in 34 as "four." The whole numeral 34 refers to the whole collection.

The last of children's non-place value hypotheses is that the numerical meaning of zero, its designation as the squiggle for "nothing" of the empty set, is the only meaning that zero has. They do not understand that it has another, non-quantitative meaning as well, and that is as a place holder. Children think of zero as meaning "nothing," and they are right about that. Zero, from the numerical standpoint, is the notation for the absence of a quantity. Nine minus zero is nine, and nine plus zero is nine as well. But zero has a dual nature, two different meanings, a numerical meaning and a notational meaning, and to understand place value or positional notation, children have to understand the second use of zero, and that is as a place holder (see Figure 7).

The Meanings and Functions of Zero
Example 1. The number ten.

1 0



The Meanings and Functions of Zero

Example 1. The number ten.

1 0

0 — Numerical meaning: empty set; no quantity.
0 — Notational meaning: zero, units place; no digit in the units position (first place to the left of the decimal point).

1 — Numerical meaning: ten.
1 — Notational meaning: one, tens place (second position to the left of the decimal point).

Example 2. The number one hundred and five.

1 0 5

5 — Numerical meaning: five.
5 — Notational meaning: five, units place.

0 — Numerical meaning: empty set; no quantity.
0 — Notational meaning: zero, tens place; absence of a digit in the tens place.

1 — Numerical meaning: one hundred.
1 — Notational meaning: one, hundreds place (third position to the left of the decimal point).

Figure 7. Zero has two functions: a numerical one to indicate the absence of a quantity or the empty set; and a positional or notational one to indicate the absence of a digit in a particular location.

The rules of our notational system provide that in the numeral 10, it is the 1 in the left-hand or tens position that makes the two marks, 1-0 stand for the quantity ten. The 0 is a place holder that shows us that 1 is written in the tens place, rather than in the units or some other postion. Similarly, in the number one hundred, no tens, and five units. The zero "holds the place of" the collection of tens and enables us to read the digit 1 as "hundred." The overwhelming response of seven- and eight-year-olds (second- and third-graders) from both low income and middle income families is to "show" the 3 4 in 34, the 3 4 in 34, and 34 as shown in Figure 6. The same results have been obtained for the parts and the whole numeral with the quantities 16, 20, 32, 100, 105, and 123.

Children think of making a double-digit number such as sixteen as "a one and a six," and not as "a ten and a six," because the single-syllable word "ten" is "10" and not "1" (one-ten and blank- or zero-ones). In the same vein, they conceptualize the elements of 34 as "a three and a four" and not as "a thirty and a four," even though in this case the verbal system supports the idea, and the elements of 105 as "a one and a zero and a five" and not as "one-hundred, zero- or blank-tens, and five."

Issues in Learning and Teaching

I think one of the ways in which psychological research can contribute to educational practice is to uncover hidden ideas--for example, the hidden ways in which children's hypotheses and theories conflict with what we are teaching them, and the hidden ways in which the ideas that we teach clash, one with the other. Observations of instructional techniques show that some teachers are unaware of the ways in which they are compounding children's confusions. For example, some adults use numerically faulty metaphors such as "going next door to borrow a cup of sugar" (rather than ten cups of sugar) to teach regrouping for subtraction. Others confuse numerical ideas with notational principles, such as "exchanging ten-ones for one-ten because a ten doesn't fit in the ones column" in regrouping for addition. This suggests that the adult has not pulled apart the notational principle (the position in which a digit is written determines its value) from the numerical idea (1 + 1 + 1 + 1 + 1 + 1 + 1 + 1 + 1 + 1 = 10, or 10 x 1 = 1 x 10).

Many children understand the numerical idea of "groups of ten" or "ten as a 'unit' composed of ten units" far before they understand the notational principle of position (Steffe, von Glasersfeld, and Richards, 1981). The process of putting together the numerical idea with the notational idea is a genuine conceptual hurdle. Some people may never make the connection, while others make it so unconsciously that they move from one to the other without recognizing it. Mathematicians will be quick to point out that that is the beauty of our notational system. But that aesthetic realization is of little help for the child-learner.

Figure 8 shows the difference between the numerical construction and the notational construction of number. Figure 8a shows how number-squiggles are akin to ordinal-labels for objects in a collection; Figure 8b pictures the sequence of squiggles that have become numerical; and Figure 8c captures the digits 1, 2, and 3 as having different values. The numerical and the notational ideas are distinct and have to be coordinated with each other.

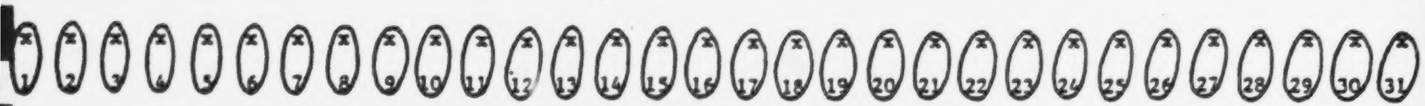


Figure 8a. Relationships between number and numerals. This figure shows the "ordinal label" idea of numerals. There is a correspondence between numerals and objects without the numerical inclusion relationship. Numerals show position or location but do not necessarily stand for ordinal number.

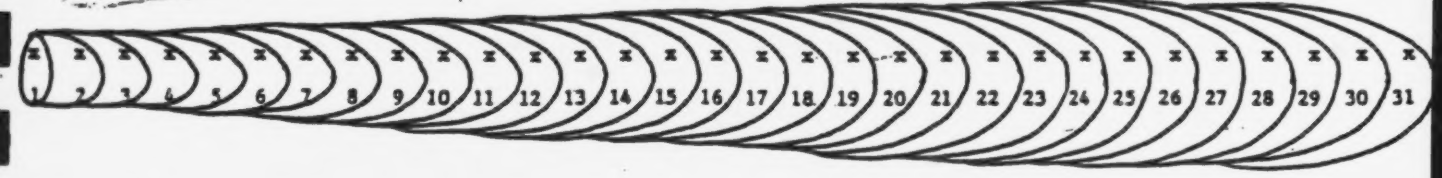
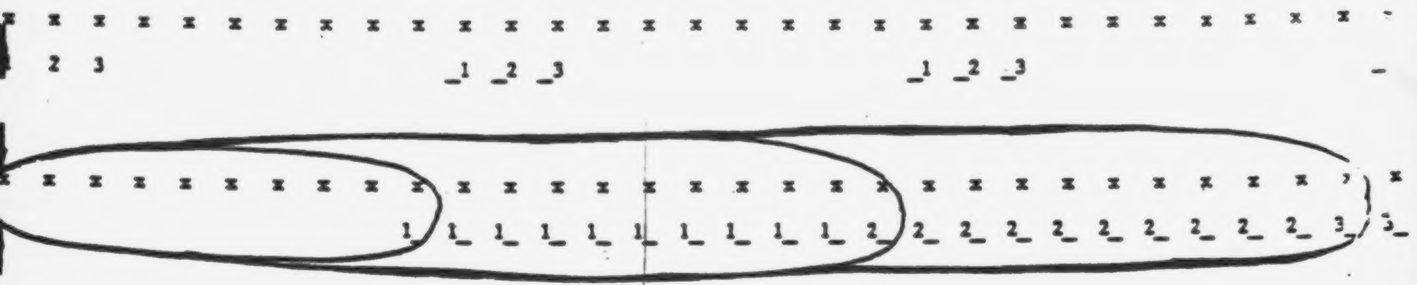


Figure 8b. Relationships between number and numerals. Numerical inclusion and serial ordering undergird the correspondenc between numerals and objects. Numerals convey the meaning of numerical inclusion and numerical order (adapted from C. Kamii, 1981).



igure 8c. Relationships between number and numerals. The digits 1, 2 and 3 carry the meaning of units in the top row. In the bottom row, the digit 1 includes ten, 2 includes twenty, and 3 includes thirty: 1, 2 and 3 refer to that many groups of ten units.

From the point of view of notation, the child has to learn (be taught) how to make ten squiggles (the digits 0 through 9); the notational principle that position has a specific number, a multiple of ten, associated with it. From the point of view of number, the child has to construct the idea of number (numerical quantity); the n + 1 idea (numbers infinitely large and, for decimal fractions, numbers infinitely small); and certain relationships such as grouped quantities. Unfortunately the progressive arithmetization of number, the process by which "beaucoup" or a non-numerical mass becomes progressively understood as the iteration of +1, is not well understood.

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Conclusion

I have described a number of clashes which I believe help to account for some of the teaching/learning difficulties with written number, and in particular with the place value property of the numeration system. One group of conflicts centers around the differences between the verbal, alphabetic, and numerical systems. The tendency of the child is to presume that the principles underlying each of these systems, as well as the correspondences between separate systems, are more coherent than they are.

The second group of conflicts is between the principles underlying number and the principles underlying notation. For number, the spatial arrangement of the objects, as well as the order in which they are counted, is irrelevant, In notation, both spatial and sequencing considerations are paramount (e.g., the order in which the steps of an algorithm are carried out). The clashes between the numerical and notational principals are nowhere more evident than in the behavior of school children who transform the digits of a multi-digit numeral into numerals in their own right (e.g., "1 in 16 means one").

The third group of conflicts is a consequence of the fact that there is no self-evident correspondence between the arithmetic operations and the conventional mechanisms for writing them down. C. Kamii (1980) has shown that performing the action of "putting together" two sub-collections into a larger whole collection, i.e., the operation of addition, is different from recording the results of those actions in equation form. The part-whole relations underlying addition and other arithmetic operations have to be constructed; the social knowledge aspect of representing the relations in conventional form has to be learned; and the action and the representation have to somehow come to mean the same thing for the child.

It is by now, thankfully, a commonplace observation in developmental psychology that cognitive conflicts, clashes between and among ideas, are a powerful source of change in the development of our knowledge. What kinds of activities and materials actively engage children's thinking, such that they themselves becomes aware of conflicts and seek resolutions to them, become critical. Without these conscious or semi-conscious conflicts, knowledge will not change; in other words, knowledge will not develop.

Adult knowers find it difficult to remember the clashes that were resolved in the process of knowledge-building. But since conflict is one powerful source of change in the development of knowledge, we might think about ways of exploiting these clashes, of helping to bring them into the conscious awareness of children, so that they may reflect on the problems and try to reconstruct the system for themselves.

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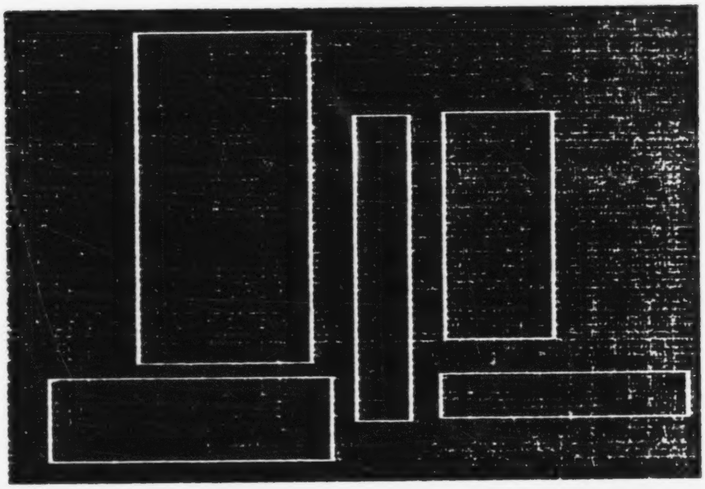
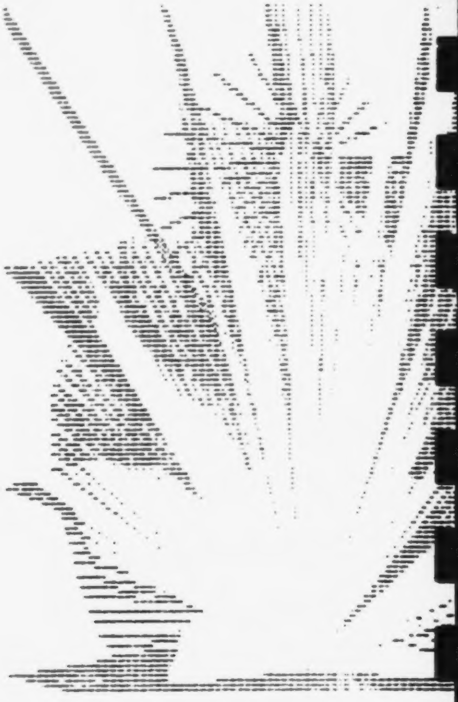




BOOKS OF THE TIMES

Christopher Lehmann-Haupt

The computers-in-education movement is here, it's perhaps the most significant trend in the history of American education, and teachers are thoughtfully engaging a variety of issues with this new and versatile ally, the microcomputer. But little research exists on children's interaction with computers. Here, published with permission from the New York Times, is a review of MIT sociologist Sherry Turkle's new book, "The Second Self." The review appeared in "The Times" June 19, 1984.

There are dozens of remarkable vignettes to consider in Sherry Turkle's Second Self: Computers and Spirit , and all they seem at first to share is their evidence of the surprisingly different ways that various people respond to computers. For instance, Jenny--a six-year-old caught up in a debate among her playmates over whether an electrtonic toy that seems to cheat can be considered "alive"--announces disdainfully, "To cheat you have to know you are cheating. Knowing is part of cheating."

Tanya, a sixth grader who is failing all her subjects despite her sophisticated sense of style and her passionate interest in language, learns to write almost immediately upon being introduced to a computer. It turns out that she simply found her childish handwriting too shameful. Gerald, an editor, buys a computer to do word processing, but finds himself good enough at programming to enter a world he had thought forever barred to him. Frank, a computer-science major at the Massachusetts Institute of Technology and a devout Roman Catholic, believes that if God permits artificial intelligence to be achieved, a "soul" may well enter the machine and use it "as its 'receptacle' in this universe."

But for all the fascinating results of these and other surveys undertaken by Professor Turkle, there are even better reasons why, The Second Self is more than just another routine study of the cultural impact of the computer revolution and its prospects for eventually fabricating intelligence. These have to do with the author's approach to her subject, which combines rigorous academic discipline with a sympathetic, even playful, imagination.

Sherry Turkle holds a joint doctorate in sociology and psychology from Harvard, and is an associate profesor in M.I.T.'s Program in Science, Technology, and Society. To write The Second Self , she spent six years studying and interviewing everyone from children undergoing their first encounters with computers, to lonely adolescents fixated on video games, to those members of M.I.T.'s community who are most obsessively involved with advancing the leading edge of computer technology.

Because she proceeds so methodically--viewing her youngsters according to Jean Piaget's model of childhood development, and judging her adults in the light of the current philosophical issues surrounding artificial intelligence--she is able to highlight the significant attributes of her disparate subjects. Not all that different are the self-styled misfits dreaming up variations of Pac-Man and Space Invaders, and the hackers and philosophers meditating on the patterns of Douglas Hofstadter's influential study, Godel, Escher, Bach: An Eternal Golden Braid .

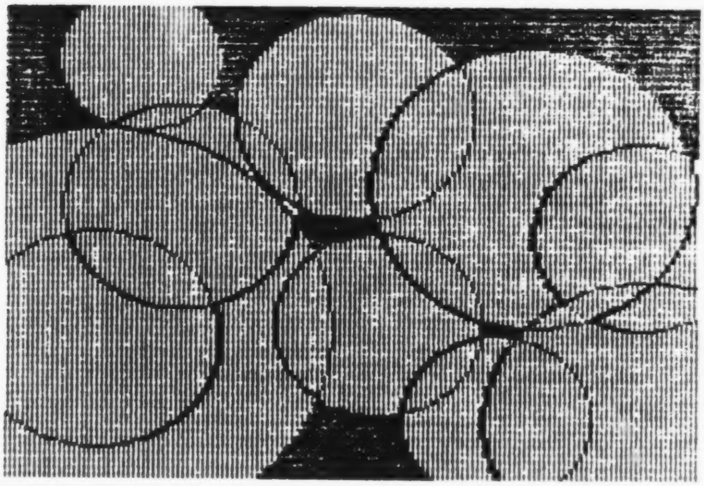
While the theorists squabble over the relative pertinence of Lovelace patterns and the phenomenon of emergence or whether computers can ever be designed to be as intelligent as human beings, the children scratch their heads and wonder if the tic-tac-toe machine knows that it is cheating. It is left to Jenny to point out that if the thinking process is intelligent, then whatever is undergoing the process must also be intelligent. That, after all, remains the gist of the famous Turing test of artificial intelligence, which proposed that if, in a fair test, a reasonable person could not distinguish between the thinking of a person and a machine, then there is no difference between human intelligence and artificial intelligence.

Perhaps even more significant, Professor Turkle comes to the subject of computers after having written Psychoanalytic Politics , a study as she describes it, "of how France, a country traditionally resistant to psycholanalytic ideas," was "swept by an 'infatuation with Freud' in the late 1960's." Considering this background, we should not be surprised that she sees both Freudian theory and computers as popular metaphors for human behavior, with the former now giving way to the latter in the public mind.

It is apt, she believes, that the computational metaphor should be supplanting the psycholanalytic one, with people increasingly talking about themselves as needing "reprogramming" instead of attributing their behavior to "unconscious drives," as they once were inclined to do. For if psychoanalysis developed in an age when hysteria caused by sexual trauma was the dominant cultural neurosis, then the computer has come along at a time when our prevailing complaint is loneliness accompanied by fear of intimacy. It is precisely to this neurotic condition that computers, with their ambiguous companionship, are so ideally suited.

Is this a good thing or a danger? As her many illustrations show, it is not necessarily either. Some people are liberated by their contact; others get stuck. "Computers are not good or bad; they are powerful," Professor Turkle concludes, having earned by the strength of her examples a right to such understatement.

And having presented with extraordinary clarity both sides of the debate on the possibility of achieving artificial intelligence, she ends up her brilliant and challenging discussion on a note of neutrality. What is significant now, she believes, is that a fascination with our machine-like attributes that has come in the wake of the computer revolution has taken the place of our fixation on sexuality that followed the Freudian revolution. "One thing is certain," she concludes, "the riddle of mind, long a topic for philosophers, has taken on new urgency. Under pressure from the computer, the question of mind in relation to machine is becoming a central cultural preoccupation. It is becoming for us what sex was to the Victorians--threat and obsession, taboo and fascination."



TENCO/SIRSEA MAC

Mary Masterson

What do we do with these computers? How do we train our staff? How do we get the most for our money? What is available for our computers? How do we keep up with the latest developments in computers? What about software? All of these questions can be answered through the TENCO/SIRSEA MAC. The MAC, Microcomputer Assistance Consortium, was formed through the aid of the TENCO/SIRSEA Center for Educational Improvement. Membership in MAC is available to all public and non-public schools located in the counties of Bond, Clinton, Jersey, Macoupin, Madison, Monroe, Randolph, St. Clair and Washington. In order for a school to join the MAC, the school must sign an intergovernmental agreement of membership and pay the established membership fee. There are two options for membership available. The first option will allow for Regional Inservice. The cost is $250 for the membership fee in the consortium and 35 cents per student with a maximum of $800 for a possible total of $1050. The second option will provide Local and Regional Inservice. The membership fee is $250 and 85 cents per student, the maximum is $1850 for a possible total of $2100. There is also a Co-op Membership which is available to Special Education Cooperatives, Area Vocational Centers, ESR's, and colleges with enrollments of under 5000 students. The membership fee for the Co-op is $250. This agreement lasts from July 1 through June 30 of the following year. Since the agreement is renewable, a school may choose to remain or drop out of MAC at the end of the year.

What are the benefits of being a MAC member? The benefits cover almost every aspect of microcomputers. In the area of hardware, the MAC is allowed to offer and accept bids on all hardware. Since the MAC also accepts bids with the stipulation that the school price will also be available to the teachers, provided they prove employment with a member school.

With regard to software, the benefits are also great. MAC offers blank single sided-double density Verbatim diskettes to the members for $1.50 each. They also have available a catalog of commercial software for the Apple, TRS-80 and the Commodore. This commercial software is available to members at a 30% discount. Some of the companies included are:

Adventure Co.
Applesoft Co.
Barron's Co.
Bus Solution Co.
CDEX Co.
Comp. Adv. Ideas Co.
Datasoft Co.
Digital Research Inc.
DLM Co.
EPYX Co.
Infocom Co.
Kensington Co.
L & S Co.
Micro Lab Co.
Muse Co.
Penguin Co.
Reader's Digest Co.
Scholastic Wizware Co.
Scarborough Co.
Silicon Co.
Sir Tech Co.
Spinnaker Co.
Sunburst Co.
Xerox Co.
American Educ. Comp. Co.
Avant-Garde Co.
Broderbund Co.
CBS Software Co.
Chalkboard Co.
Continental Co.
Desktop Co.
Dilithium Co.
Edu-Ware Co.
Harcourt Brace Co.
ISM Co.
Koala Co.
The Learning Co.
Micro Pro Co.
Odesta Co.
Phoenix Co.
Rock Roy Co.
Scholastic Co.
Sierra on Line Co.
Sirius Co.
Sorcim Co.
Strategic Simulations Co.
Synapse Co.

New companies are continually added to the list. MAC also has access to public domain software. If a member school makes its own copies there is no charge for the copy. If MAC provides the copy, then there is a $5.00 charge. MECC disks are also available for purchase at $4.00 each and documentation at MECC's cost.

The MAC has also proved to be invaluable in Communication and Information. In February, they began a Computer Assisted Instruction Sharing Forum. These Forums were scheduled throughout the region from 4p.m. to 6p.m. These Forums give teachers an opportunity to get together with teachers in their grade group or subject matter area. The intent is to share their evaluations of good and bad software, their feelings about computers, and children's responses.

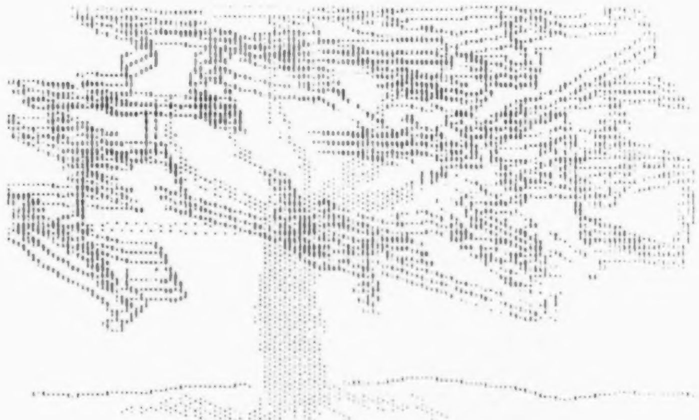
The MAC also provides written evaluations of educational software. They constantly review articles, books, and periodicals to update members on their findings. The consortia will also keep track of evaluations of software being used in member schools. They will also subscribe to national software evaluation newsletters as well as being connected statewide for software evaluation assistance.

The workshops are another important benefit of the MAC. MAC provides numerous regional workshops on various aspects of the microcomputer. The consortia is able to reduce the normally high priced fees for these workshops by spreading the costs out to participating members.

The local inservice in my own personal experience is well worth the cost of the membership. Gail Vogeler provided our district's inservice workshop. She assumed we knew nothing about the computer. She began teaching the computer at the beginning. She discussed the terms we would hear, instructed us on the use of the computer, taught us how to initialize a disk, how to program low level graphics and how we might evaluate software. We were hands-on from the beginning until the end. She showed us some good software as well as some poor software. The workshop continued for 15 hours-- 3 hours one night a week for 5 weeks. I felt comfortable with her and she made me feel competent enough to go into my classroom and use the computer. If the consortium's other consultants are as thorough and knowledgeable as Gail, I know the workshops on other aspects of the computer use would be of equal value.

I've given you a brief overview of the TENCO/SIRSEA MAC in the hopes that this information will be of some benefit. If you would like further information contact:

Jed Deets, Director
TENCO Microcomputer Assistance Consortium
Educational Development Center
1505 Caseyville Avenue
Belleville, Illinois 62221
(618) 277-4530



WASTING AWAY IN COMPUTERVILLE

Carol Anderson

My experiences with computers, both on a personal and professional level, have ranged from bad to miserable. A one week workshop in programming was my first experience. It left me vowing never to touch a computer again. For two years, I was successful in keeping my vow, until my father, who feared I had closed my mind to growth, bought me my very own TRS Model IV. Needless to say, it was not the gift I most desired. He knew, however, that my natural curiosity would get the better of me and if it sat there, staring at me, I would soon relent and poke around. Slowly, I began to put to use what I had learned. I was shocked to discover that in that one week of frustration, something really had sifted through.

Added impetus came when my school district decided to purchase computers. Two Commodore 64's arrived in my library in the fall. I was on my own with no in-service training, no one-on-one with a company representative, and no release time. This did not add any new positive experiences to my bank.

Along with the computers came the directive to order software. As the Instructional Media Specialist, this was my job. My desk became a pile of catalogs. I was besieged by salesmen.

For the district, computer literacy was the goal and I could work on that, too. All of these things, including my carefully honed distrust of computers, had to be juggled and the whole package sold to equally reluctant teachers.

After analyzing my negative encounters, I determined that I could put my negative experiences to use. I could try to make computers less offensive to the teachers who were to use the machines.

I very determinedly insisted that the literacy program be put on hold until we could acquire more computers. We would use the time to develop and plan an organized program and I would devote the computers to another use.

I began a soft-sell program of teacher training. First of all, the sessions would be voluntary and include no programming. Then, I promoted the philosophy that the computer was the district's newest A-V machine. If we could learn to operate a movie or filmstrip projector, we could learn to operate a computer. Finally, I circulated the news that I would be working on the computers before and after school and would appreciate any moral support available. One teacher showed up and together we played and discovered. I made no schedules; I merely made myself available and kept the time frame flexible.

As we played the discovery game, we wrote down everything we did and how we did it so that the next time it would not be a serendipitous event. Eventually, we had a mini user's manual that was much easier to understand than the official one accompanying the machine.

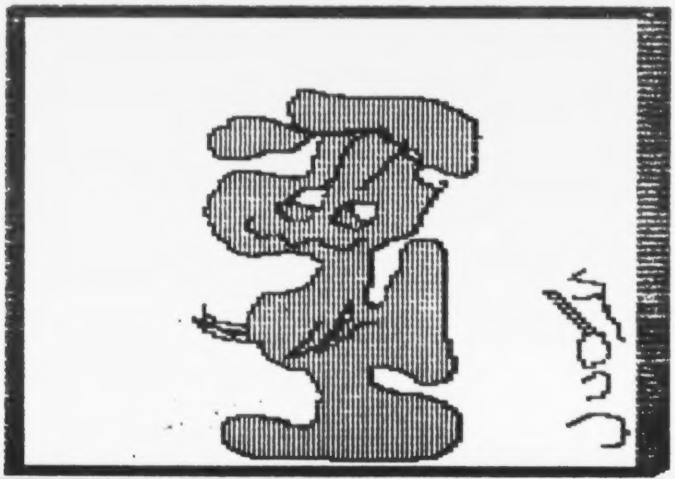
At the next meeting, another teacher showed up and again we cavorted with the computers. As one individual became comfortable, he or she would drop out and another would enter the group. We taught each other, laughing and joking our way through the hour. Insidiously, computer literacy spread through the faculty. It is amazing how provocative laughter can be.

The goal was not one hundred percent participation, but rather positive interaction with the computer and with one another in the interest of children's learning. The main secrets of the program's success were the availability and flexibility of the teacher trainer and group support. Just having someone around to supply a forgotten manuever or to suggest a remedy is a great boom to an all-around feeling of success--and positive experience was what I was seeking.

A RECIPE FOR COMPUTER SURIVIVAL

1 cup lime juice
1 cup Triple Sec
1 pint tequila

Stir together with ice in a pitcher and serve in salt rimmed glass. Used sparingly, this will reduce computer induced tension and fatigue and make the user very friendly. Overuse will lead to loss of memory, increased random access, and a user glitch ultimately resulting in a floppy user.



YOU'RE ON YOUR OWN: BUYING SOFTWARE WITHOUT A LIBRARIAN

Carol Anderson

As a junior high school librarian, I never realized how abandoned some elementary teachers are. I never knew how many teachers are responsible for purchasing their own computer software without the aid of a professional librarian to whom selection is a way of life. I would like to offer a basic plan for establishing a software aquisition procedure.

First of all, read review sources and journals for background and/or elimination. Use at least two sources and more, if possible. If the negative comments seem to be piling up, you may wish to delete an item from your list. Still, for me, there is always the nagging feeling that just maybe there is more there than meets the eye and seeing the material for myself is the ultimate convincer.

Secondly, know what kinds of equipment, including peripherals, are needed to run the program. This information usually accompanies the catalog description or is found in the review. If a particular bit of software requires mouses or memory you don't have, take note.

Next, request the material for preview. It is risky at best to invest in a program sight unseen. If you cannot get a preview diskette, make note of this company; this could be an indication of the cooperation you will get after purchase. You may try other sources for preview--libraries, universities, other districts or schools, or your regional superintendent's office. Here your loan period may be shorter than the thirty day plan allowed by most companies. Still, it is better than nothing.

When you are requesting preview pieces, ask whether backup disks are available upon purchase. This is an important item for your future sanity and if the company refuses this service (perhaps at a nominal cost) do not be afraid to take your business elsewhere. As a consumer, you have a great deal of leverage. Often by pressing a salesman a bit, you'll stir up magic to ensure his sale.

When your program arrives, preview it first as an individual without outside influences. Then field test it with your kids and note their reactions. Then share it with a colleague or two. Other eyes may see things you don't see and you'll all be richer whether or not you buy the piece.

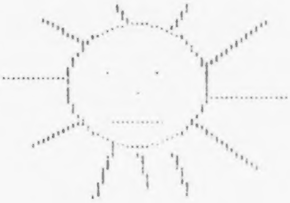
While previewing the program, evaluate it using questions tailored to suit your needs. Do not allow yourself to be limited by published checklists. Scribble notes and observations as necessary. Evaluate the program in relation to your instructional needs. Do not be razzle-dazzled by glitter. Keep your objectives in mind and keep the needs of your kids in mind. Look, also, for errors on the diskette. And look to see whether there is a teacher's option which you can control.

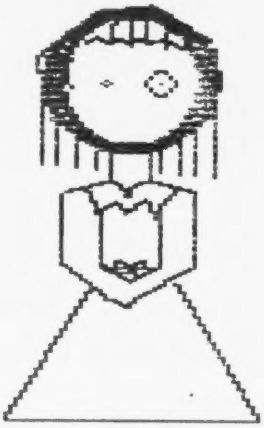
Relate what you see to what you read in the reviews. Look for what the producer says it can do, but also look for other applications. They can sometimes be more exciting than the original intent.

Especially look for ways in which you can continue the activities in regular classroom use (beyond the use of computers).

After completing the form, do not panic if a lot of checklist no's are circled. Some things may not apply to your program. Go back to check the things really important to you. It is now time to weigh the things desired that it offers against the things desired it lacks.

Finally, consider the dollar value. Sometimes you get lucky and find a good program at a good price. Remember, also, that an expensive program is sometimes no better than an inexpensive one. Do not discard public domain material. Some of it is not very pretty but some of it is still pretty good.





CHANGING LIFESTYLES: AN OVERVIEW OF COMPUTER USE FOR THE DISABLED

Joanne Anderson

Physically disabled people have a new friend...the computer. Many new and innovative ideas have made the computer a valuable companion to physically disabled people. Not only has it become a companion, but a tool for learning and in some cases a necessity for daily life.

Computers can be set up for use by bed-ridden individuals. Monitors can be placed anywhere for easy viewing while the keyboard stays at the fingertips. Homebound people now can touch the outside world. With the aid of CompuServe (an information service), they are able to see and/or hear the day's news as it comes over the AP wires. Not much different than a television you might say, but what about the added delight of meeting new friends, sending letters, receiving mail, and,playing partner chess even while confined to bed? Just a finger's movement or a voice command can now introduce new and exciting experiences to an isolated soul.

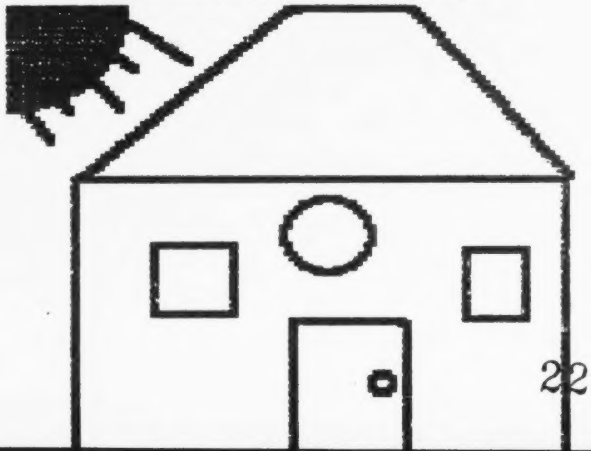
The computer that produces synthesized speech has two primary applications, reading for the blind and speaking for the vocally handicapped. There are two approaches to speech synthesis. One is synthesis by analysis, which produces a natural human voice but is limited by the number of words in its memory. The other option is synthesis by rule, which uses a complex set of linguistic rules and has an electronic quality that gives it a mechanical and alien sound, but is not restricted in vocabulary.

Several programs are available for the blind. Wordprocessing and programming can be executed because the keyboard is able to "echo" each key that is touched; instantly the user is made aware of mistakes. Even if errors arise, the computer can read aloud the text to the user allowing for fluent composition.

The physically disabled who are also hearing impaired can now communicate without sign language. The ability of the computer to understand either the typed or spoken command allows it to produce replies on the screen enabling the deaf to read responses.

Many recent strides in computer technology have opened the doors for the disabled. Not only is it a tool, but on occasion a lifesaver. Alarm systems attached to the computer can safeguard the home environment and the medical needs of the disabled. Instantaneous responses from the police or fire department can save lives. The computer also has the ability to monitor medical equipment and safeguard their properly functioning life-support systems.

All in all, the computer is making progress in normalizing the environment for the physically impaired. It is a tool and a friend that helps the disabled to enrich their lives.



Ready, Set, Go!

Geraldine Farthing

What do I know about computers? Not much, but I'm learning. That's what I want my classroom children to do! Learn to do exercises with their brains that I can't get them to do in the allotted time we have per day. Learn on the basis of one to one, or small group interaction, and I can do this with a computer. No more just sitting there--do something, learn! I don't want to be a passive educator, I want to be in on the action, don't you? What's new? What works with kids?

I have read about computers in news, business, and educational magazines, but reading about computers doesn't give you enough input. You need to use one yourself to be convinced. Watch a small group of children or adults brainstorm about the solution to a given situation. More thinking can take place in a few minutes than most children, or adults, do all day. The challenge of memory, analysis, and application of the principles needed can create excitement that is refreshing to encounter.

The machine is not going to cause you nearly the problems you might have thought. It has an on and off switch. The keyboard is familiar, much like a typewriter. It has a small disc drive that functions like a tape recorder only much more efficiently. The most important part of the computer is the material you feed it, the software. The floppy disc is the software that contains the program note you choose to use. This is what is important! You determine what the appropriate challenge is for your student or students.

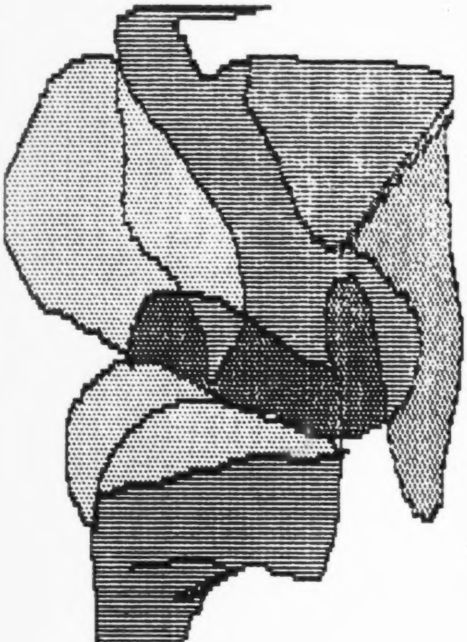
The majority of educational materials that are available have been prepared for intermediate age children and beyond. But there are good materials available for young children and everyday something new is being developed. Most of us take for granted the use of audio-visual equipment in conjunction with our teaching. There is nothing new about filmstrips, film, or slides. Just as some film materials are choice teaching tools, so there are choice software discs available for your use.

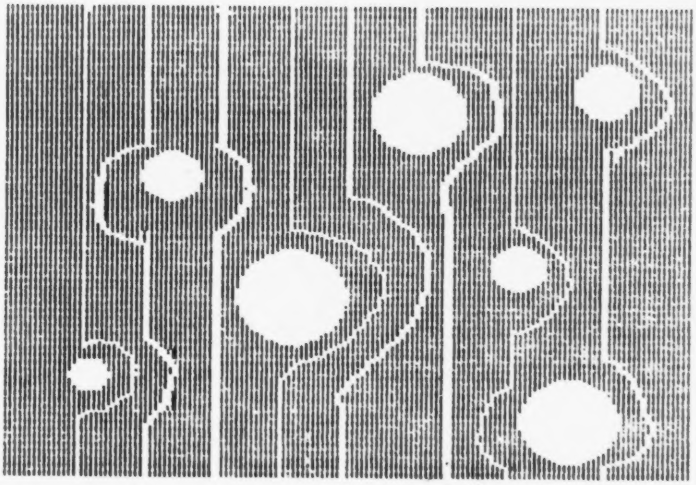
How do I select software is the next question. Well, get some input from other teachers, read reviews in computer magazines, look at catalogs and order for preview the discs that sound like they would fit your needs. Be careful! All that glitters is not gold! Don't buy the window dressing. Go through the program and determine its teaching effectiveness. Does it develop learning more capably than a book? Has it been developed creatively so it will hold the attention of children? Is the content revelant to your childrens' needs? Is the information presented clearly and in a manner that can be controlled by the children? Are the instructions clear? Is the program written so the correct response induces a positive reward and an incorrect response will not 'shoot down' the children, but will encourage further exploration? Is the overall development of the program of good technical quality? Does it have a teacher's guide and all the other back-up information you need to make the most effective use of the program? Is it practical to use, or too involved for children to be able to proceed after simple instructions are given? This will give you some ideas to begin evaluating software.

After you know how to get this far, you are ready to use a computer in your classroom. It will require classroom management so schedule the computer for your classroom use, then plan about twenty minutes for each child, or for small groups to interact as you feel the children are ready.

You must instruct the children about the do's and don'ts of your computer, and software, depending on the age of the children you are teaching. The machine doesn't like bubble gum or Coca Cola and the software doesn't like fingers on its open window. Otherwise, there's not much damage one can do.

Now you are ready, GO!





Electronic (Computer) Music in Music Education

Angela R. Jones

Today, music educators cannot ignore the technical revolution that has taken place during this century. The possibilities that come from the technical revolution of computers and the related fields of mathematics and science can no longer be ignored. However, the art of computer music is still too new and too experimental to have any established methods or any substantial body of literature that may serve as a foundation for a systematic presentation of its aesthetic or its structural principles.

Computer or electronic music is defined as music created in the laboratory using electronic sound generators and techniques made possible by magnetic tape recorder. One problem that is faced by music educators in the use of electronic music is its bond to traditional music. The electronic medium must first be accepted or rejected as a valid artistic vehicle. Of course, the nature of music does depend on physical laws and a physical agent (the instrument) to produce the sound.

Traditional music education has in the past accepted the timbres of conventional instruments as representing the totality of sound resources. Because electronic music is more sound-oriented, more emphasis is placed on the physical aspects of sound. Before a pedagogical method of studying electronic music is developed, the acoustical aspects of music should be explored.

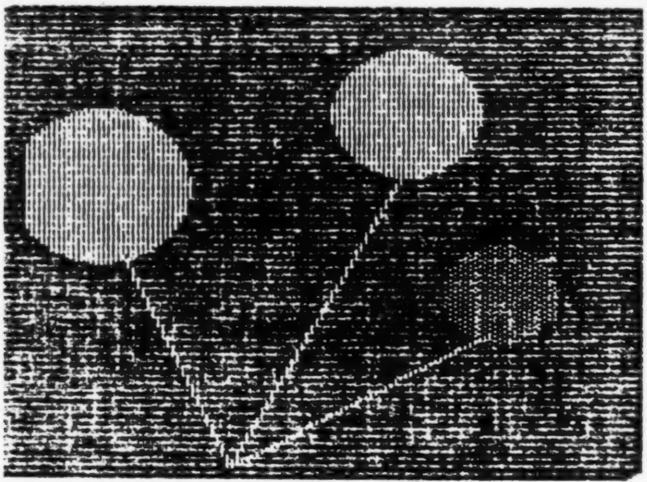
The purpose of music education is to provide aesthetic choices to the student that might normally go undiscovered. Many students feel intimidated by traditional methods of music education, and may never allow themselves to explore these aesthetic choices. The average person can explore the world of music without the requirements of long hours of practice and expensive individual instruments. Electronic music in music education can be used to expand the average student's knowledge and appreciation of music. Most importantly, the student experiences the music as well as makes the music.

Fundamental elements of traditional music are also used in electronic music. The elements such as key and time signatures, clefs, note and rest values, pitch, timbre, duration, and intensity of a sound (systems of notation and coding traditional music), can become a resource to the electronic music student.

The role of the composer of electronic music changes from that of the traditional music composer. The traditional music composer has somewhat of a passive role because he is the receipient of instrumental resources, whereas, the composer of electronic music has the power to create an infinite number of timbres (tone color) through synthesis. Therefore, the role of the electronic music composer is more of an active role.

The active role of the student can be used to the advantage of the teacher. The method most effective in teaching electronic music is the discovery method. Students are naturally curious and easily motivated to learn about the new equipment and new sounds. The student is challenged to discover more about music through his attempt to learn about the function of the electronic units and establishing the range of the generator. This method of teaching can generally inspire the student to learn in all areas of the school curriculum. Because most of what the student learns is what he discovers, the confidence and motivation gained by his experiences in discovering electronic music will enable him to enjoy other learning experiences.

Electronic music, like music presented through any other media is a result of the interaction of man with his environment, both in terms of its sound source and its reflection of mid-twentieth century, techno scientific concerns. The teacher must be able to remove any musical prejudices he may harbor, his own functionally conditioned listening habits, and introduce his students to music he may neither accept nor understand. The music teacher should realize the academic potential of electronic music as a motivational tool for creativity, insight, and inspiration. He should also recognize the electronic music lab for creating an environment for individual thinking and intellectual growth.



Are Our School Systems Meeting Their Purpose?

Angela R. Jones

Today, educators are not only concerned with what basic subjects to include in the public school curriculum, but they are also plagued with the question: What is the purpose of our educational institution? Many people feel that these institutions should also meet the needs of the society as well as prepare our children academically for the future. That is, children should be educated to recognize changes in our society, and the problems that come with change. Children should be educated to recognize when "systems: (man-made or natural) have been reduced to uselessness. Children should be taught how to think intellectually, and how to be a part of the mainstream, but at the same time, separate themselves and view the world objectively and intellectually.

The environment directly influences perceptions of our children. Therefore, it is believed by some that the school should also be responsible for educating students about their environment outside of the school. Almost everything that the child learns is learned because the environment is organized in such a way that it permits or encourages or insists that you learn them. The process of learning is directly affected by the organization of the environment.

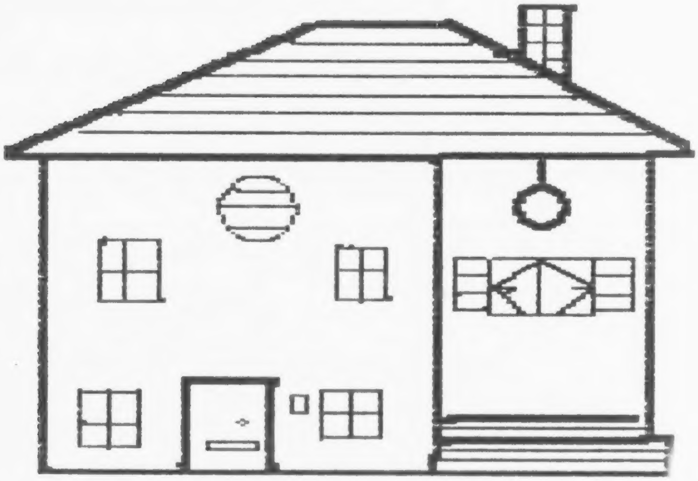
How then, can this organization of the environment be best utilized by teachers to result in motivational learning experiences of the student? Does our teaching method act as a catalyst to real learning? Does our teaching method stimulate thinking? Do our students actually learn and can that so-called knowledge be transferred and applied to new situations?

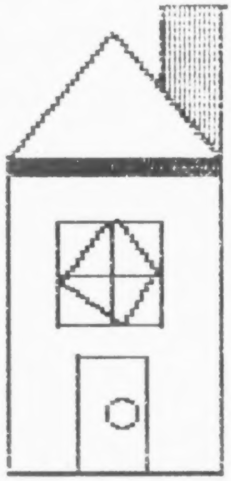
Studies show that it is not what you say to people that counts, but it is what you have them do. Behaviors promoted by the classroom can be understood by what students actually do in the classroom. What they do in the classroom is what they actually learn. If there is nothing going on in the classroom, the student learns nothing. If the teacher does all of the thinking for the class, then the class learns how to let someone else think for them. If the student is not allowed to question the facts before him and/or draw conclusions from the facts, then he does not learn how to hypothesize and use deductive reasoning. If the student is not given problems to solve, he will not learn problem solving techniques.

Students are mainly required to memorize facts, sit and listen to the teacher. They are usually asked questions where they simply just supply the right answer. They are seldom required to make observations, formulate definitions, or perform any intellectual operations that go beyond repeating facts. They are rarely encouraged to ask substantial questions. School environments are characterized by partial and temporary memorizing of someone else's answers to someone else's questions. Once the student has learned how to ask substantial and relevant questions, they have conquered the process of learning.

It is also essential that the student consider whatever is to-be-learned as worth learning. In order to activate the learning process, the student should perceive a problem as a problem, and he should play an active role in determining the process of solution. If the student does not view whatever is to-be-learned as relevant, then he will remove himself from his formal education, or the classroom.

The purpose of the school, therefore, is to present to the student the source of knowledge; that is, the art and science of questions. the curriculum of our school systems should center around arousing the natural curiosity of the student, i.e., question asking. It should center around problems that are perceived as useful and realistic by the learner, as well as problems that will prepare the learner for future survival. There is nothing more worth knowing than the continuing process of how to formulate workable meanings from problems that result in solutions from our questions.





LOGO LEARNING ACTIVITIES

Ginger Gornall

To use Logo's turtle graphics, students need to be able to understand the concepts of left, right, forward and backward. Before working with Logo on the computer, I used several methods to help the students to gain control of the new language. We practiced the turns and movements with our bodies through games like Simon Says and our own Logo parade. The Logo parade gives the students practice in following and giving the Logo commands orally. One student is selected as leader of the parade. This person calls out the commands to the other students who are lined up behind the leader. The leader must remember to give the number of steps to move forward or back just like the turtle commands in Logo. Another activity to help with learning the commands is a turtle toss game. To play this game a student is selected to be the turtle. Make a card with the forward command printed on it to pin to the front of the turtle. Make another card with the backward command to place on the turtle's back. Make cards for left and right and tape them to a pair of mittens. The person who is the turtle wears the cards and the mittens. The other students give the turtle commands to reach the beanbag on the grid.

To further the students' understanding of the commands, we next worked with moving objects in response to the commands. I made a large magnetic chalkboard turtle to demonstrate the commands for the class. To make the turtle, cut out an isosceles triangle 3 inches wide at the base and 5 inches high. Draw a simple turtle shape on the center of the triangle. The head should point away from the base to the top angle. Place a magnet on the underside of the turtle to make it stay in place on the board. The students can give the commands and take turns moving the chalkboard turtle.

Students can make a smaller version of the chalkboard turtle for their own use. Have them draw a turtle on a pre-cut triangle and then label the sides of the triangle for left and right. This will help the students to determine if the turtle moves to the left or to the right. Using the individual turtles, the students can place them on their desk tops with the center of the desk being HOME. The students can then follow simple Logo commands to move their turtle around the desk top. These activities helped the students relate to the movements of the turtle rather than relating to the left or right of the computer screen.

After the students have become familiar with the Logo commands on the computer, you can do activities to help them estimate and judge their commands more carefully. Make simple transparencies of planet shapes to represent an outer space scene. Students must start the turtle at one of the planets and move it with Logo commands to the other planets. Initially, the object is just to arrive at each planet. As the students improve in their estimation of angles and distances, challenge them to record their moves and reduce the number of moves to reach each planet. These transparencies can be taped directly over the computer screen.

SO...YOUR SCHOOL FINALLY DECIDED TO GET A COMPUTER!!!!

Judith K. Hall

Believe it or not, you do not need a College Math Degree, a computer history course, a computer theory course, or a computer language course to use a computer in your classroom. But you might want to consider three areas before getting started:

(1) school board/principal commitment
(2) teacher exposure/training
(3) software criterion

A very important area is to get a commitment from your school board and principal too:

(1) get the faculty in on the choice of computer(s) bought:

*which brand, or brands, have the most and the best software to choose from
*what kinds of extras can be added to the computer
*service available

-and-

(2) insure that money will be available for computer education for the faculty:

*to buy more computers

*to purchase more software on a somewhat regular basis

*to send people to workshops to gather ideas to share with the rest of the faculty.

Once you have a commitment from your school board and principal, all of the teachers and personnel need a gentle exposure to the very simple mechanics of this wonderful educational aid:

*locate on and off switch

*how to slide in a disc and gently pull it out when finished

*how to get the computer to read the disc.

and to have the computer available to them (even to taking them home over the weekend, or over the summer!!!) to become comfortably confident with the machine, as well as allowing them to further their own knowledge through available software. This training should occur before the machines are brought into anyone's classroom or computer center. Teachers need to feel confident on the computer before they take it to their kids.

While the faculty is being gently introduced in the simple mechanics, there should also be training in the proper way to choose the software they will be using. A good way to do this is to preview many kinds of software from different companies in various subject areas at the same time they are being introduced to the machine. As they look at various pieces of software, the following areas might be considered:

"EDUCATIONAL QUALITY"

*is it at the appropriate reading level?

*does it follow a logical order?

*does it follow your objectives?

*is the content accurate?

*are there any follow up activities that can be used in your room?

*is the feedback from the software appropriate for your kids?

*is it an appropriate use of the computer? (Or is it something you could do just as well with a textbook or with physical apparatus?)

"CLASSROOM REVIEW"

*will the publisher allow a free 30-day preview of the game?

*are there any pre-motivational activities included?

*does it challenge the child to think through a problem rather than rattle off answers?

*is it relevant to success as proposed to speed?

*does it deal with important issues?

*does the glitter, if any, help or hinder learning?

"SUPPORT MATERIAL"

*are directions clear enough for the student to understand?

*are there any dittoes, transparencies, etc....available to accompany the game?

*are there any off-line activities?

"TECHNICAL QUALITY"

*is it laid out attractively?

*are the screens appropriate for children?

*is the software color dependent?

*is there a teacher option to control some of the data fed into the activity?

*is there a filter in the program to screen out objectionable input by children?

*is it user friendly? Does it bomb out unexpectly?

*are the questions clearly stated?

*does it allow you to start a problem over if it has become too confusing or too hard without losing your score, question, or level?

*does it allow for the user to drop down or go up a level depending upon the difficulty of the problem?

These are not hard, fast rules. Instead, it is a guide to help you find software which will aid in the development and improvement of your children's thinking. There is so much software out there to look at, so BE CRITICAL! GET THE BEST! Don't go for glitter! Go for CHALLENGES! Don't settle for memorization, go for THINKING!

Believe it or not, if you take the small amount of time for gentle training you will be itching to get that machine in your classroom, and to get your kids on the software you have so wisely chosen! At this point you will have become a 'pioneer' (to use a word from LeRoy Finkel) with your kids and you will all get off the ground successfully and learn tremendous amounts from each other. Don't be a 'settler' (another LeRoy Finkel word) there! KEEP GROWING with your kids! This is a very important tool that both you and your kids need to use NOW as well as in the future!

CRITERIA FOR JUDGING GOOD SOFTWARE

Mary Ann Lutz

In order to be able to use computers effectively with your curriculum you must be able to judge software so you can make wise choices in purchasing software to fit your needs. When evaluating or judging software there are four areas to consider. The four areas I will be sharing are ones that were shared with me during a workshop I took this summer.

I. Educational Quality and Value of the Software:

(a) Are the directions and questions clear and concise?

(b) Is the information presented accurate?

(c) Is the program motivational and does it involve use of skills or concepts that have already been learned?

(d) Does the program provide feedback and handle a student's mistakes positively, so the student doesn't feel like a failure?

(e) Does the program progress in a logical order or sensible educational sequence?

(f) Is the program the appropriate level of difficulty to fit your needs?

(g) Does the program promote childrens' thinking?

(h) Is the software reasonably priced?

II. Technical Value:

(a) Does the use of color and/or sound foster learning or interfere with the educational effects?

(b) Can the user of the program be in control? Can he control the number of problems he wishes to do? Can he get out of one program and go to another program if the one he is doing is too easy or too hard for him?

(c) Are the questions clear?

(d) Are the pictures used clear and accurate enough for the student to interpret them as they are intended to be?

III. Teacher Value:

(a) Are the objectives of the program clearly defined? Are they worth achieving, however clearly they might be stated?

(b) Is there any supplementary material available?

(c) Is the program one that can be used either individually by a student or cooperatively by 2-3 etc. students and still foster learning and thinking without confusion?

(d) Is the program one that fits your classroom needs?

(e) How much time is required to use the program and how much teacher preparation time will be required? Does it require a teacher's constant attention?

IV. Student Value:

(a) Does the program promote childrens' thinking?

(b) Are the visual displays attractive and appeaing to kids in a way that promotes the desire for them to learn?

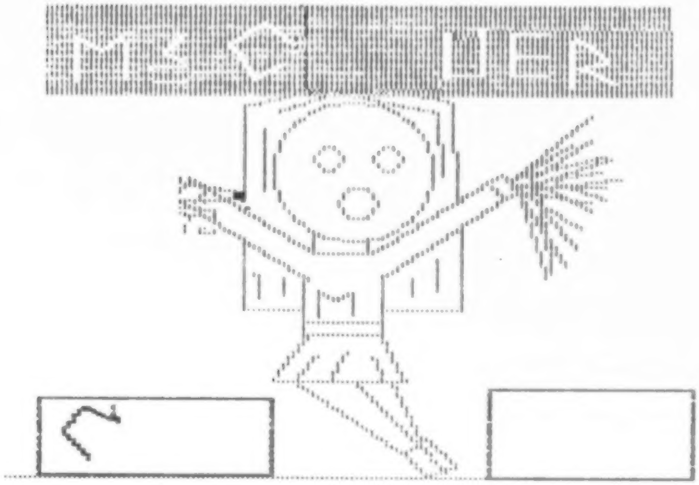
(c) Are the directions and problems clearly stated in a way that is familiar to the kids?

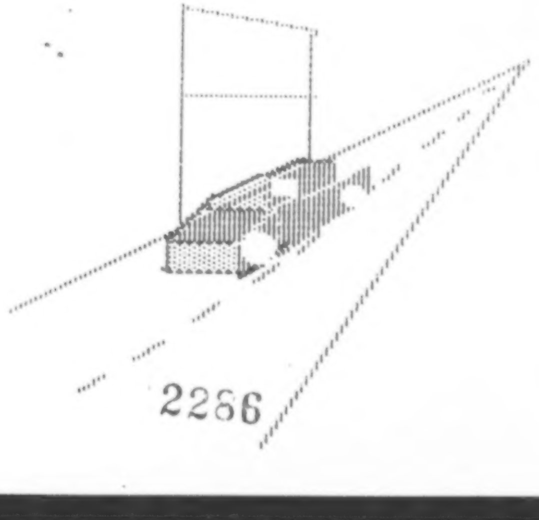
(d) Is the program motivational?

(e) Is implementation of the program suitable? Can the students easily use the keyboard?

(f) Does the program allow the student to use already learned skills and apply them in solving new problems?

The above things are just a few things to consider when choosing good software. Don't be fooled by the cosmetics of software. Just because it has beautifully colored graphics does not mean it is a good piece of software. It must be educationally and developmentally sound, fit your classroom needs, and "Go Somewhere." IT SHOULD PROMOTE STUDENTS' LEARNING AND THINKING!





TEACHERS TALK -- THE FAILURE OF COMPUTERS IN EDUCATION?

Thomas C. O'Brien

In the early 1970's a school principal told me that The Open Classroom didn't work. "We tried it," he said. "We moved all the desks and chairs from the classrooms into the halls. And the kids sat on the bare floors of the classrooms. It didn't work. The kids got cold bottoms. We kept it up for two weeks but then we moved all the furniture back into the classrooms. The Open Classroom was a bad idea."

Sadly, much of the history of American education is a history of bandwagons, ideas which were adopted rather than adapted, which were installed without much serious thought about purposes and underpinnings, and which were parachuted from on high without teachers and administrators engaging issues in a thoughtful and serious way. The bandwagons came in a flurry, promised sun, moon, and stars, and vanished without a trace. Some of them deserved to vanish; witness the absurd interpretation given Open Education above.

What's the fastest vehicle in a vacuum? A bandwagon!

Now we have another bandwagon on our hands -- computer assisted learning. It will not be long, I predict, before American education throws up its hands and cries "We tried it. We gave it our best. Computers don't belong in the classroom!"

But are computers being given a try?

I am an author of computer software. I am a user of computers to the extent that I can reasonably say that they have transformed my life. (Virtually all my print material, professional and private, goes into a computer and nightly I check into my electronic mailbox.) I am a teacher educator and a researcher on the intellectual development of children who has written widely about computers-in-education (See Classroom Computer Learning, September and October 1983, and Phi Delta Kappan, October 1983). It is clear to me, and to many others, that computers are spectacularly versatile tools which increase one's personal firepower almost without limits.

There is no question but that computers can play a major role in education. That they will is far from certain.

Recently I conducted a course on computers-in-education. Some 25 elementary school teachers took part. During the course, I asked participants to describe the state of the art as they knew it locally. Then I asked, what would they want to happen?

What's happening in local schools? Here are the comments, paraphrased for style. I have separated the comments into three sections: hardware, software, and in-service education. What would teachers like to happen? That section follows. Then comes the author's summary and commentary.

HARDWARE

"The principal buys the hardware and sticks us with it as though to say 'I've done my part. You're on your own'."

"My school administration bought a boatload of TI computers just after TI left the education market. Why? They were on sale at $49.95. The problem is that there's virtually no educational software for the TI so we've shelved them."

"My principal bought a bunch of cassette driven Pets because they were cheap. We've got a bit of software, not much, but now he's ordered some Pets with disk drives but no new software. We've having one of our seventh graders translate from cassette to disk over the summer."

"My school has no computers at all."

"My school has 4 computers for 3500 students in K-12."

"The PTO wanted to support the purchase of computers but no one knew what to do, so we settled on price as the criterion. The computers are on the shelf because there's no software."

"We have one computer in our school. It's upstairs. It never gets downstairs."

"Every school in my 20-school district has one computer bought with district funds. They are used solely for Instructional Management System record keeping. There are some 200 other computers in the district, but these were all purchased with PTO funds."

"A custodial mentality seems to prevail. Buy the machines (at the lowest cost possible and without much attention to their educational use), then protect them. Don't, for Heaven's sake, let kids touch them; they'l break them!"

"Computers in my school are used for administrative purposes only -- record-keeping, principal's letters, etc."

"A lot of school administrators say that they're gung-ho about computers in education. But their heart isn't in it and they often don't know what they're doing. They want to look up-to-date to the community."

SOFTWARE

"Teachers in my school thought that the computer did it all. They didn't know that there was such a thing as software. Buy the computer, they thought, and you're on your way."

"I am amazed that there's other software than MECC software. We were told that MECC was the only software producer."

"My school district has a policy that drill-and-practice software is the only stuff the slow kids get to see. I may be wrong, but I think that all kids -- especially these kids -- need to see something other than rote connections. If they don't see something different, they'll continue to sink in the sea of rote meaningless memorization."

"I am proud of my colleagues. The only software they knew of was provided by one company, and it was dreadful. Many of them refused to use a computer in their classroom because their professional conscience was violated."

"My school uses computers but I don't. The only use of computers in my school is that something like 37.14 X 778.23 is shown on the screen, the kids work the answer out by hand, then the teacher pushes a button and kids check their answers. That's not good education."

IN-SERVICE EDUCATION

"We've had no in-service education in our district. There's a once-a-year county institute where some of the sessions deal with computers in education."

"We had a half-day workshop -- 3 computers over 100 teachers -- at the beginning of the school year. It took place on the afternoon of the first day of school, just after we had met our new kids for the first time. We had gobs of decisions to make on the basis of our morning's meeting with our new classes and no one paid much attention to computers. Nothing has taken place since then."

"We are expected to squeeze in a knowledge of computers amidst everything else. No time is provided to give the issue any real attention."

"A bunch of us took a course on computers. The course amounted to elementary computer programming. That wasn't what we were looking for and we dropped out in droves. Those who finished the course were able to produce rudimentary programs which drilled kids on state capitals, exactly the sort of thing that's in workbooks. Workbooks or computer software, I ask whether state capitals are important issues for kids to engage."

"Most of my colleagues have no idea that computers can be used for word processing, for graphics, for music, for problem solving, for old and new topics and new approaches to math and history and language, for information services such as CompuServe and The Source. The computer is a drill and practise machine, they think. They don't know that software publishers such as Conduit, Spinnaker, Sunburst, The Learning Company, Scholastic, MECC, TIES, and CCW even exist."

"We took a LOGO course and we spent all our time drawing pictures. There was no attention given to the power of LOGO as a computer language, to the important issues of LOGO (such as recursion, variables, nesting of procedures, etc., which are immensely powerful intellectual tools), or to the non-graphics uses of LOGO."

"Our school has a Computer Priestess. She took a week's workshop and that put her far above the rest of us. She only works with games and elementary programming. She's reluctant to help us, to share her priesthood. She won't share her manuals or her software. If we want help, she'll do the work rather than help us to do our own."

"Some of my colleagues are using a computer just to be able to say, 'I'm using a computer.' They have no real feeling about how a computer might fit productively into their classroom."

"The way we were introduced to computers was wholly inadequate in terms of time and depth and gaining useful knowledge. What would you think of a NASA astronaut training program which consisted wholly of a half-day's rush through Mission Control in Houston? You'd scream about your wasted tax moneys."

WHAT WOULD YOU LIKE TO SEE?

"School administrators should think about computers as new and important educational tools, not as hardware like desks and urinals. They should focus on the role of computers and software in education, not on mere dollar savings and not on computers as a way of gaining good PR for themselves."

"School administrators should spend the time and the energy and the thoughtful reflection, in collaboration with teachers, that computers-in-education deserve and demand. If not, they should turn over the reins (and give support) to those of us who know (and who want to know more) about the issue."

"Teachers should have time and support to make the issue their own. They should have several months of constant access (perhaps in their home as well as in school) to computers and gobs of good software before using computers in the classroom. One hundred hours of interaction with good computer software should be a prerequisite for any teacher planning to use a computer with kids. That given, teachers should have constant opportunities to acquaint themselves with new materials. This is a fast track. A one-time introduction, however lengthy, won't do."

"Beware of salesmanship and slick marketing and glossy packaging. Beware of colorful screens masking poor education. We're dealing with the lives of kids. We're not selling aspirin or Buicks."

"Beware of company kickbacks to assure purchase of hardware and software. 'You're a heads-up educator. Can I buy you a dinner at the Four Seasons?'"

"Teachers should have easy access to print background on computers-in-education and they should have easy access to hardware and software reviews. But don't swallow someone else's review whole-hog. The best test is one's own tryout. And don't discount word-of-mouth (grapevine) comments, which often have more veracity than the professionally produced review."

"Most of the good educational software comes from small publishers. Let's dig and find out what's available and not settle for something just because a salesman brings it to your front door. About half the software publishers, I've learned, have a 30 day free preview policy. Let's tell people that this is so and let's encourage and share serious evaulations."

"School districts should provide roving educational and technical consultants, something like the educational advisors in the British schools. Educational advisors -- perhaps teachers on a rotating basis -- would spread ideas. Technical advisors would fix small glitches (perhaps even by telephone advice), thus saving the 30 days' down time often involved in off-site repairs."

"Let's move away from priests and priestesses and intimidating technical language and a focus on electronics. It would be laughable to get so technical with other commonplace tools, such as telephones or televisions. Let's use this tool for the well-being of children. Let's marshal the power of computers in education and stop diddling around with self-serving esoterica."

"Don't ever feel that you're finished. This computer stuff is constantly growing and it helps you to grow. I have the feeling that 'the sky's the limit.'"

CONCLUSIONS AND COMMENTARY

The comments here came from elementary school teachers in Silicon Desert. Whether they are generalizable over the nation, I don't know, but I suspect readers will recognize some of the points as pretty close-to-home.

What springs out, I think, are several points:

1. Teachers are honestly concerned about the well-being of children, their judgment is often on target, and they are often ill-served and ill-supported in their professional quests.

2. Computers-in-education, one of the only educational movements in concert with American socialite trends (unlike "modern math" and ITA and dozens of other bandwagons over the past twenty years) offers great promise to American education. The reports of teachers suggest that the history of previous bandwagons is being repeated. Computers are not being seriously engaged as educational resources.

3. On one hand, teachers are treated as pawns with ideas and policies parachuted from above. On the other, they are invited to innovate, so long as they do so in their spare time, with only nominal support, amidst the burdens of ongoing obligations. Can't teachers be viewed as essential partners in educational advancement? Can't time and support be provided them to do a worthwhile job?

4. We are "tacking on" computers to an already overcrowded and disarticulated curriculum.

For example, we spend endless hours teaching arithmetic computation to elementary school children with exhaustive (and exhausting) attention to speed and accuracy at a time when 4 million long calculations can be performed in one second. Could we engage children's time and intellect more fruitfully? Need we continue to prepare children for a world which is long last?

Perhaps we should re-think the curriculum in terms of the availability of computers in home, schools, and industry now and in the Twenty-First Century, where present children will spend most of their lives. Computers are super at memory tasks. They are not very good at thinking. People are very good at thinking but not so good at memorizing. Have we got things the wrong way around in the present curriculum?

Does our present curriculum prepare children for the lives they will lead in the Twenty-First Century?

5. Will we hear, two or three years from now, "We tried computers in the classroom. It didn't work."? Local evidence suggests a clear-cut Yes unless educational improvement is undertaken as a fundamental task by teachers and school administrators.

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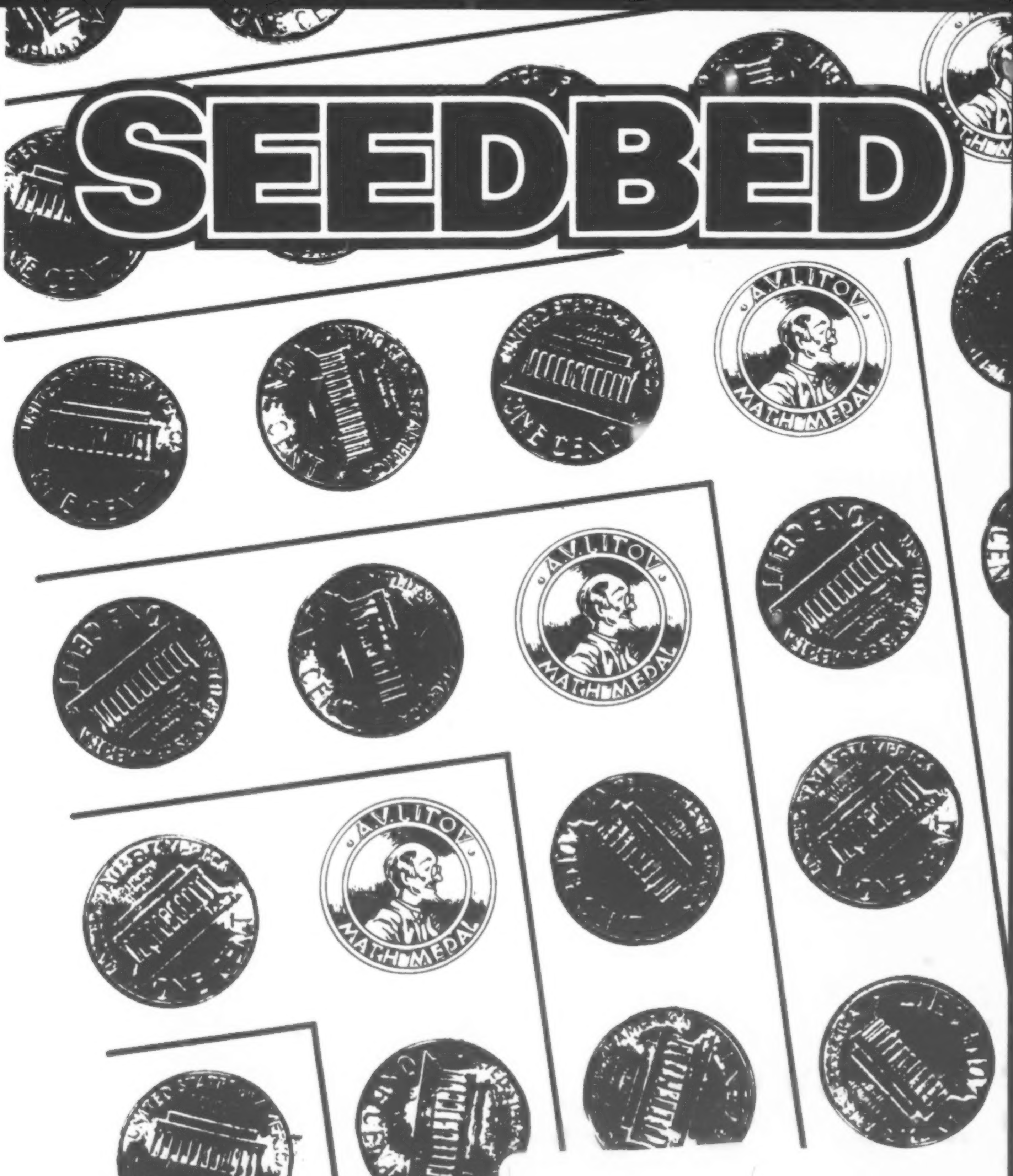
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Teachers' Center Project

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INTRODUCTION

In summer of 1984, thanks to generous support from the Jessie Smith Noyes Foundation, New York City, the Teachers' Center Project sponsored three week-long seminars for teachers involving two British educators, David Lingard (Headmaster, Northcliffe Comprehensive School, Yorkshire) and Sylvia Johnson (Research Officer, National Foundation for Educational Research).

The sessions took place at CalState/Fullerton, at the Boulder CO Public schools, and at SIUE.

Much of the present SEEDBED comes from Lingard-Johnson participants at SIUE.

But the present SEEDBED is woefully inadequate in conveying the richness of the Lingard/Johnson seminar. For one thing, the warmth and goodwill of the daily sessions can only be weakly expressed on paper. What a smashing session it wasor another, it is impossible to convey the amazement and delight of participants when they found that much of what they knew -- and knew as fact, hard and clean -- was susceptible of vast elaboration and vastly different application in classroom situations. Finally, many of the issues from the seminar are still bubbling around in participants' minds, and it is simply too early for them to come public.

Fair to say, the view of mathematics and of mathematics education in which we were immersed by Lingard and Johnson is very, very different from what is commonplace hereabouts. That view is perhaps best expressed by the seminar leaders themselves in an interview included here and soon to be published in The Mathematics Teacher.

By the time you read this a dozen Teachers' Center participants will have taken part in a follow-up week-long seminar on David and Sylvia's home ground. As this SEEDBED goes to press we are packing our bags. If things go as planned, a future SEEDBED will deal with our June 1985 seminar experiences and week-long immersion in Yorkshire classrooms.

Warmest thanks to the Jessie Smith Noyes Foundation for their support of our work.

Warmest thanks also to Barbara Goldenhersh, who handled the editing of the present SEEDBED, and to Patricia Atkinson, staff secretary, who provides the glue that keeps the operation together.

Tom

Thomas C. O'Brien
University City, Mo.

June 1985

ABOUT THE COVER

One of the thorough-going themes of the Lingard-Johnson seminars was the richness of intermixing visual mathematics (geometry, if you wish) throughout the mathematics curriculum.

We were asked to find out whatever we could about the differences between consecutive squares. Most of us American-trained teachers dutifully listed a bunch of squares -- 1, 4, 9, 16,... and diddled around with conjectures and often a bit of algebra -- $(x+1)^2 - x^2$ and so forth. "Picture what you are thinking," said David and Sylvia. The room was filled with "Ooh"s and "Ah"s as teachers' numerical and algebraic notation leaped to life. "THAT'S what those symbols mean" was a frequent comment.

What can YOU find out about consecutive squares using pennies? What illumination does visualizing cast on other aspects of your mathematical knowledge?

One need not use Litov Memorial coins, by the way. U.S. pennies are O.K.

QUOTES

Scattered throughout this SEEDBED are quotes from various sources. The quotes headed POLYA were presented by Professor George Polya at the International Conference on Mathematical Education, Exeter, 1972. Said Polya at the time; "Some of the following passages are literally quoted or translated. Others are paraphrased (condensed, modernized...) Parentheses are used to indicate inserted words. I tried not to distort too much the meaning intended by the authors. At any rate, as I read them, these quotations greatly helped me to clarify my opinions and they may find responsive readers."

NOTE

A note about "typesetting" in this SEEDBED; The computer printer did not print exponents in the usual way. Can you muddle through and break the code? Second, the printer did not print exclamation points. Thus, reader, you are invited to punctuate the text with exclamation points wherever you see fit.

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BRITISH EYES ON AMERICAN MATHEMATICS

David Lingard, Sylvia Johnson, and Tom O'Brien

* * * * * * * * * *

A modified version of the following transcript is soon to appear in The Mathematics Teacher, the journal of the National Council of Teachers of Mathematics.

* * * * * * * * * *

During the summer of 1984, the Teachers' Center Project of Southern Illinois University at Edwardsville sponsored three week-long courses for teachers. The sessions, funded by the Jessie Smith Noyes Foundation, took place at California State University/Fullerton, the Boulder Valley (CO) Public Schools, and Southern Illinois University. The course-givers were David Lingard, Head of Northcliffe Comprehensive School, Yorkshire, and Sylvia Johnson, former mathematics chairman at Northcliffe, now research officer for the Department of Education and Science. Both Lingard and Johnson are active in the Association of Teachers of Mathematics, the British counterpart to NCTM. Ton O'Brien is professor and director of the Teachers' Center Project at SIUE.

Thomas C. O'Brien: During the Thirteenth Annual Summer Course of the Teachers' Center Project we have had the opportunity to have David Lingard and Sylvia Johnson with us from Yorkshire. One of the things that I would like to ask them to address is the commonplaces that we have in American education, the things that we take for granted. Maybe two pairs of fresh eyes can help us to see things that we have not seen before.

Also, I'd like David and Sylvia to talk about the differences between what they've seen of U.S. mathematics education and what they know of mathematics education in the U.K. In this way, perhaps we can learn a bit about ourselves and about other people's views of teaching and learning mathematics.

David Lingard: There are a lot of immediately obvious differences. One major difference is the fact that in England we teach mathematics to children from kindergarten age through to the equivalent to twelfth grade, whereas in America, particularly in the high schools, it seems that arithmetic, algebra and geometry are taught as separate courses. The first time I came to look at American mathematics teaching two years ago I was astonished to find that a student could spend the whole year in mathematics doing nothing but arithmetic or nothing but algebra. That simply couldn't happen in England. Mathematics is seen as an integrated subject.

Sylvia Johnson: One of the other big differences is that it seems to be laid down that a child age 8 ought to be able to do this and a child age 9 ought to be able to do that. In English schools, there is much more of an acceptance that different children of the same age will have very different abilities and what is appropriate for one child might not be appropriate for the next child.

David: Going back to the algebra, geometry, arithmetic issue, one noticeable difference is the almost total absence of geometry from the high school curriculum and the concentration on arithmetic and algebra. A number of high school teachers have said to me that they only do geometry if they've got time left when they finish the algebra and arithmetic, and that geometry is given scant attention. To particularize, I understand that Pythagoras' Theorem is usually taught in tenth grade because that is when the geometry course comes, if at all. In England Pythagoras' Theorem is often taught in seventh or eight grade, together with a lot of other geometry. You could argue that it does not really matter when it is taught, but as a good deal of mathematics is dependent upon the use of Pythagoras' Theorem then if you have not done it before tenth grade you're preventing kids from making progress in some areas of mathematics.

Tom: Can I back up a moment? I think it may be wise to explain briefly what you mean by geometry. To us geometry means the tenth grade course with lots of theorems to prove. Given the week that we've been through at SIUE, it's fair to say that you're interested in visual relationships?

David: Yes, essentially, I think what we're trying to do with most kids in school in England, as far as geometry is concerned, is to develop spatial ability. The fact is that we live in a three dimensional world and kids are experiencing geometry all around them every day. I think it's our job to help kids be aware of that. Another reason is that geometry can be so illuminating to the algebra and arithmetic. We had one example this morning here. We were looking at the differences between the squares of consecutive integers 7§2 - 6§2 =13; 8§2 - 7§2 =15, etc. And Shirley Casey made the point that it was not until she saw a geometric representation of the issue that she really saw and understood why the difference between the squares was always going to be odd. We've had many other examples during the week where the geometric representation of a particular situation in arithmetic helped people to understand what was going on. I think mathematics teachers ought to be looking all the time for ways of supporting what they are saying in as many ways as possible and getting kids to look at things in different ways. Very often geometry helps kids to do that.

Sylvia: There's another very big difference, which must be quite a conflict for American teachers. I'm sure American teachers care a great deal for their pupils, but there seems to be more of a genuinely pupil-oriented approach to the whole of education in England than there is in America. And that goes right through to the extent that the level of communication between teachers in English schools seems much higher. For example, in my department in England you would talk about the kids you were teaching and how they got on with this or that part of the curriculum, what mistakes had happened, and what hadn't gone well with this or that child. As a department you would talk about what grades you were going to award. You would meet as a department and discuss all these things. That seems to be almost vetoed in American schools. It is not regarded as professional to discuss pupils and their work, whereas it is regarded as one of our professional responsibilities of a teacher to share the responsibility for the education of each child. I might talk to an English teacher about how a child I'm teaching mathematics to is getting on in English. That sort of thing just seems to be non-existent here, from what I've seen.

Tom: Any other differences that might be appropriate to mention?

David: There are lots of differences. Take the textbook issue. It is clear that in America, mathematics teachers use a book for geometry, a book for algebra, a book for arithmetic, and so forth, and that book will be used by all the teachers in a school and very often all the teachers in the district or even in the region. That is totally unknown in England. There are lots and lots of books and pamphlets and home-produced material (produced by teachers themselves in their own schools or in their own homes) available to children. Teachers have considerably more freedom and responsibility in England than they do in America. There's just no question about that. As a mathematics teacher in England I can use whatever I like providing it meets with the general approval of my head of department. On the whole I can choose whatever texts the school has available. As I say, most schools will have a variety of texts and pamphlets, equipment and apparatus and home-produced material available to teachers and kids. I will be very eclectic about how I use these materials. I will pick this book because it has a good chapter on so and so. I will pick that book cause it has a good chapter on such and such. And very often I will do my own material because there isn't a book with a good chapter on this or that topic at all.

Sylvia: Teachers here seem to feel that they have a course to teach, and they do that by going through the textbook. (In some cases we have met teachers who've said they use a wide range of things in addition to the textbook.) But it's still very much, "This is the course that we have to teach and it is the pupils' responsibility to make sure that they understand the course." And so teachers will say things like, "I will set homework every night and it's the kids' responsibility to do it. I will collect their books in to make sure they have done the homework but it's up to them to let me know if they understand or don't understand, what they've done." In several situations I've seen, the teacher will not correct the books. They will just check that the work's been done.

That seems to me to be very different, professionally, from the role expected of a teacher in England. It is the teacher's job to make sure that the children understand what they are doing, not the pupil's job. And as a head of department, I would expect teachers in the department regularly to collect the books, mark them, check them sensibly (not just put ticks) and to use that assessment of the kids' work in a diagnostic way, to follow up as to which individuals haven't understood, to provide extra help as needed. It wouldn't be up to the kids to come as a group and say, "None of us understands this." Now in some cases kids will do that, and if a kid does come to you as a teacher and says, "I don't understand this," obviously you respond to that. But it's primarily your responsibility to look at what the kids are doing, to diagnose what's good and what's not good, and then adjust your teaching accordingly.

Tom: Which gets us into the area of assessment. One of the commonplaces that is thoroughgoing in the U.S. education is the domination of tests. They are dominant. And they are externally produced.

David: Yes. That's very different. Just before I comment on that, let me go back to the textbook domination again. We talked about the proliferation of classroom material in England. Certainly one of the profitable developments in terms of education, not finance, that's happened in England in the last 15 years has been the growth of teacher-produced material for the classroom. This is not just the individual teacher producing worksheets at home in the evening, but groups of teachers getting together to write materials for the classroom which are then made available to wider groups of teachers in various ways, usually in a non-profit making way, a cooperative way. There's been a considerable explosion of that style of working.

In England the first public formal external assessment takes place at the end of tenth grade. For the majority of kids this is the CSE assessment (Certificate of Secondary Education). Teachers have the opportunity to control this form of assessment, i.e. to write the syllabus, determine appropriate methods of assessment and carry out assessments. The Examination Board controls things administratively, moderates between schools and teachers to ensure that standards are maintained and actually awards the grades. The grades are awarded on the basis of teacher assessment. Many teachers take advantage of this very real opportunity to control the assessment of their students.

A minority of kids, approximately the most able 20 per cent, take a different form of external assessment at the end of tenth grade leading to the General Certificate of Education (GCE 'O' level). Here there is more control by the Examination Board, but the pattern is changing and increasingly syllabuses are including some form of school based assessment.

Tom: You're talking about the 'O' levels?

David: Yes. But interestingly this is all changing. In 1986 a new system of assessment is being brought in to replace both 'O' level and CSE. The new system of assessment which will be used with the majority of tenth grade students will again give teachers the opportunity to control the methods of assessment and to some degree syllabus content.

Tom: But if this is so, the obvious American question would be, "What about standards?"

David: Why is anybody suggesting that teachers who are professionals should not be able to determine the standards as well as anybody else? I mean, if teachers don't determine standards, who does?

Sylvia: I would like to raise here what I see as a myth in the so called objectivity in the American system of grading. We have been told that teachers are often required to grade pupils every week, sending a grade home to parents. But, we have also been told about the complete lack of communication between teachers about the grades awarded. So one teacher awards a grade A for work for which another teacher might award a grade B and so on. The argument is that the nature of the work attempted determines the grade. Yet work can be done in a variety of ways to a variety of depths and assessed to a variety of standards. With no discussion between teachers it seems that leaving the award of grades to one teacher is far from objective, nor can it ever be.

David: That's right. Where you've got teacher-controlled assessment in the schools as in England, teachers have to meet. I have to go along with the other nine teachers teaching tenth grade and sit down and compare the work my kids have done with what their kids have done. Let's look at their work and compare and see if your grade "B" means the same as my grade "B" and so on. There has to be what we call internal moderation, which means a lot of discussion and argument, and often soul searching between teachers working within a department to determine standards.

Tom: What's an example of a test question? Choose a level and give us an example of a test question that might be used with children in your school.

David: An example from a ninth grade CSE examination paper--I'm picking a geometric one deliberately--went something like this. Here's a right angle triangle. (There was a diagram of this triangle giving its measurements.) The first part is very straight-forward. Calculate the area of the triangle. Then it said, "You could put some triangles like this together to make an equilateral triangle." Calculate the area of the equilateral triangle. Then it said, "Six of these could be put together to make a hexagon. Show how you could do this." Then it went on and said, "You could put a number of these hexagons together to make this flower arrangement (which was drawn out). What is the width of this arrangement? If you wanted to create a flower pattern arrangement twice as wide, how many little triangles would you have to start with?"

Tom: And the way of reaching a response might differ very much from Johnny to Mary to Steven?

David: I think there would be some variation in that sort of question. There'd be a wider variation in other questions. For example, in a number pattern paper that we used this year a question said, "Choose two numbers and write them down with the second larger than the first. Add them together and form a third number. Now add the second and the third number to form a fourth number. Now add your third and fourth number and form a fifth number and so on. Then they were asked to take each pair of numbers in turn and divide the smaller by the larger and to comment on what they noticed. Certainly you get wide variation here because every kid might have chosen two different numbers to start with and kids would have approached the problem in a slightly different way. And written a range of comments and explanations.

Tom: One of the commonplaces here in the U.S. is the multiple choice test. Do you ever use multiple choice basis tests? Do you always look at the actual child's work?

Sylvia: By and large, there are few multiple choice tests. Most assessment is done by requiring pupils to write down solutions to problems, and teachers mark the solutions. One point here is that one can get the highest possible grade on an exam and have few right answers. How you approach a problem, how you tackle a problem, is given far more marks than the final answer.

We have discussed assessment of the sort of investigation work that David was talking about, with teachers on our present trip. There might not be a single answer to a problem and you can't just assess that sort of work by requiring (or even no) correct solutions to a problem. That is a very, very big difference in approaches to assessment. The way a student tackles something and the method that he or she uses is of far greater importance than whether or not they get the right answer. You can make a simple arithmetic slip and get the wrong answer and that should count minimum against you compared to your method of solution.

This does raise another issue. When we talked about devising a marking scheme which took into account the processes the kids have gone through, their methods, their work, tackling a problem and allocating marks to that and not just to the solutions, teachers we met said that they weren't prepared to do that. It would take far too much time, they may have 120 scripts to mark, and they certainly weren't going to spend a lot of time doing that every week. Now that comes back down to the grading system and also to teacher continuity. We don't do it every week. We expect to mark like that every term or whenever the assessment is--maybe every half term--for one class of 30 kids. It would be unusual for us to have three or four classes all doing the same course at the same age level. So we wouldn't be in the situation where we had 120 scripts to mark, all of the same, every week, to that degree of depth. There seems to be a Catch-22 situation here. If teachers are going to grade work according not just to whether the kids got the right answer or not, they're going to do it more thoroughly and they can't be doing that for 120 kids every single week.

Buried in all of this is another question, the question of who teaches what. Teachers must have a very boring life here if they teach four classes, all the same course. It would drive me batty. It seems important that you teach through the ability range within your school so that you have an idea of how kids progress. It also seems important to me that you keep kids for longer than--in some cases, we were told--half a semester. There is no way I can really assess a kid's work within half a semester.

David: Yes, there is no way that you can get to know children in that time when you're seeing them say three or four times a week and there are 27-30 kids in the classroom and so on. If I teach a ninth grade class, I will certainly expect to see them all the way through ninth grade and all the way through tenth grade. In fact, in my own school we're moving towards a situation where we see kids right through eighth grade, ninth grade and tenth grade with the same teacher for their entire mathematics course for three years. That's how you get better assessment of students' capabilities. The teacher gets to know the kids, gets to know their particular strengths and weakness and builds up the relationship with the students. You know what they like doing, what they will worry about, what they will fear and back away from, etc.

Just going back to what Sylvia said, to put it very hard line, two or three teachers in Boulder actually said when pressed that yes, their main criteria for devising a method of assessment for students was "Is it easy to mark?" In other words, could the teacher do the job pretty quickly or not? If they couldn't then it was a bad test.

Tom: You disagree with that?

David: Sure. If you are doing a professional job and you are trying to assess students' abilities, then you've got to devise appropriate methods of assessment. Appropriate methods may not be ones that are necessarily easy for the teacher to mark. Going a bit further on that, also in Boulder, but I suspect I would have got the same answer in California or Illinois, I asked about teacher continuity with classes. I asked why this didn't happen and they said this was just how the schedule was arranged. I said "OK, supposing I am a high school principal in Boulder and I say we're not going to do the schedule like that this year. I'm going to arrange that every mathematics teacher takes a class through for two or three years continuously. Are you saying somebody's going to stop me?" And they said, no, they didn't think anybody would stop me. In fact Jim Robinson (Boulder) said that it was up to any high school principal to take that line. So I said "Why don't high school principals change things?" And the response I got to that was, "That's a good question."

Tom: Let me build on that issue and ask you to talk about the role of the school principal, which you call a head teacher. What is the role of the head in your school?

David: I think I have two major roles. One of those is what I would call staff development, and the other is curriculum development. As to the first, the staff development, I think it's my responsibility to create a climate, an atmosphere, in which teachers can grow as well as one in which children can grow. Now there are all sorts of things you can do. You can simply suggest to teachers that they take opportunities for inservice training by going on this course or that course. That's one very obvious thing. You can support the work of teachers by working with them in their classrooms or covering lessons for them to release them to go to watch other teachers working by arranging a departmental program for that opportunity to happen. I can do it by working with heads of department who in turn work with their department to increase their professional skills. There are many ways in which a head can contribute to professional development of his or her staff. That is one of two major parts of my role.

The second part is the development of the curriculum for the children. That is an activity which is contributed to by all the teachers in the school. Departments have meetings to consider their courses and update them, change them, revise them, modify them, shuffle them about in terms of what's suitable for what age groups. They devise new material, buy new material, find new equipment, try different things out, evaluate it, comment on it, discuss it, and so on. That's a process which is going on in our school all the time in every department and that's something which, as head, it is part of my job to make sure is happening, to create an environment in which that does happen, and to help people want it to happen.

Can we talk about problem solving?

Tom: Yes. It's one of the big issues in the United States. Problem solving is a widely used word these days but to American mathematics teachers problem solving largely, no, not largely, almost universally means word problems. "Three birds sat on a fence. One of them flew away. How many birds are left?" They amount to computational exercises couched in words. One straightforward question, do you do word problems in your curriculum at the primary and secondary level?

Sylvia: Well that isn't what we mean by problem solving.

We do use word problems, though not in the same way as you do here. They are used particularly with lower attaining pupils as an introduction to interpreting mathematical situations presented in words.

David: Problem solving as we use it is often more open and often more investigational, although not always so. Very often the sort of problems we're talking about are ones where there is no immediately obvious way of doing them. A couple of months ago we were talking with David Fielker former editor of "Mathematics Teaching" and director of The Abbey Woods Maths Teachers' Centre) and David suggested that a problem was only a problem when you didn't have the solution. If you had a solution you didn't have a problem. Now that obviously doesn't hold water entirely as far as working with kids is concerned, but I think it's quite a nice way of putting it. Suppose I take two right angled isoceles triangles and put one on top of the other in a certain way and say, "What is the area of the intersection of the two triangles?" That's a problem. I can't solve it immediately. I don't know the answer. I don't know how I'm going to start until I get into it. I would call that a problem. You can't look at that and say, "Ah, yes. The way to tackle this is to use such and such a strategy. So your first problem is "What bits of mathematics can I use here?"

Sylvia: There seems to be a growing awareness in America of what we would call problem solving skills. And there seems to be a danger that these are going to get hived off into problem solving courses where we have five lessons on finding all the permutations and then we have five lessons on using tabulation, and then we have five lessons on drawing diagrams rather than integrating these abilities into the mathematics that you are doing. Quite a number of teachers we've talked to have seen problem solving techniques as something very different from the mathematics they are teaching. It seems very important at this point in time in America that it doesn't get separated out. There seems to be a very big danger that schools are going to start putting on problem solving courses alongside their algebra courses and the two are not seen as related.

David: That just wouldn't make any sense to us at all.

Tom: This week we practice drawing diagrams, next week we practice coming up with a conjecture, next week we practice some other isolated aspect of problem solving. There is a danger, yes.

From the course that we've been through, can you recap and come up with some good examples of problem solving to illustrate what problem solving involves.

David: I don't know where to start. O.K., there's one on the board which came up this morning which begins 6 = 1+2+3, 9= 4+5 etc. What other numbers are sums of consecutive numbers? 9=2+3+4. What numbers can't be made like this? Find the numbers that can be made in four ways or five ways. And how many ways can you make 2342?

Tom: 9 can be composed into two consecutive numbers. 6 can be decomposed into three consecutive numbers, 1+2+3.

David: And 15 can be decomposed into 7+8, 1+2+3+4+5, or 4+5+6. And I think I'm right that if you check 105, it can be decomposed in 7 different ways.

Tom: There's some orderliness happening here perhaps. Can you test that orderliness? That's what the problem calls for?

David: Yes. And can you generalize it. In other words if I give you a number, can you tell me how many ways you can decompose it into consecutive numbers?

Tom: Another problem that we dealt with this morning deals with the difference of two consecutive squares. For example, 8 squared minus 7 squared. 8 squared is 64 and 7 squared is 49. 64 minus 49 is 15. 8 and 7 add up to 15. What's going on here? Does this always happen? Can you show geometrically that this always happens? Can you show it algebraically? Can you relate the two?

Sylvia: We could extend that particular problem. What happens if the numbers are not consecutive but, say, consecutive odd numbers or consecutive even numbers. So its 8 squared minus 6 squared and 9 squared minus 7 squared.

David: Problems often lead to other problems that children invent. One of the advantages of working with children like this is that it allows them to be creative and to see mathematics as a creative activity, not as a subject which exists and has always existed and will never change and has stopped developing.

Tom: "It's in the books and somehow I have to get it into my head." That's not the sort of thing you're talking about.

David: No, it's not.

Sylvia: It's also accessible to a wide range of abilities within one room in that a lot of problems of this sort have within them problems for the least able kids and problems for the most able kids. And it's therefore quite appropriate to do them with a class of a particular age group and engage all kids despite their varying abilities.

David: Can we switch topics? Just looking around the room I'm reminded of the things that we've been doing this week. You started out by asking what are the noticeable differences between math teaching in America and in England. In the last five days we have used dominoes, counters, cubes, geo-strips, dice, scissors, about ten different sorts of paper, including spotty paper in many different forms.

Sylvia: Geoboards.

David: Geoboards, pinboards, peg boards, sticks, applicator sticks, etc. And that's just in five sessions with a small group of teachers. All of those things that I've mentioned, together with a host more that's around this room at the moment, are part and parcel of any good mathematics teacher's stock cupboard in the classroom in England. If I took you into any mathematics classroom in my school at home, you would find all those things readily available.

Tom: And yours is secondary school.

David: That's sixth to tenth grade.

Sylvia: And they're used with tenth grade kids.

David: If I say to a student I want you to picture taking three cubes and sticking them together face to face. How many different ways can you do that? With three cubes the good student will be able to visualize that and sketch it. But if I say, "OK, now take five cubes and stick them together in as many different ways as you can face to face," even the most able students will not cope without actually getting the cubes and sticking them together, looking at them, turning them around in their hand, looking at them from different perspectives, putting them on the table and comparing different models. The use of materials and apparatus pervades good math teaching.

Tom: American education has been influenced very heavily by the back to basics movement. What have you seen here? What is taking place in England?

Sylvia: It is certainly apparent that elementary school level teachers here are being required to teach arithmetic operations to pupils which in some schools in England have completely disappeared. Some teachers have talked about having to teach fifth and sixth graders division by 3 digit numbers. They're required to do that. There is not a single teacher at Northcliffe who is required to do that with any of their kids because that seems to be an outdated operation. We have calculators in most examinations now. Students are allowed to use a calculator for some of their papers and many arithmetic routines that we used to spend a lot of time on are dying out. Logarithms appear on very few papers now and schools who are still teaching them are being encouraged to just drop them because it's an outdated way of working (unless you're talking about the most able people who might go on logarithmic theory). But it's certainly true that the level of arithmetic skills which are expected here are way, way beyond what's expected in England. There has been in recent years a slowing down, if you like, of expecting children to master certain arithmetic skills. Even elementary teachers now are questioning whether or not they ought to be trying to do things like 2 3/4 multiplied by 4 1/2. They just wouldn't touch that now, whereas I get the impression here that that's very much part of required curriculum, almost exclusively the curriculum. I sense the feeling that the more you practice these the better off you will become. In England, there's been an awareness that that actually doesn't work. There are lots of things which even if we practice them everyday we still can't remember them two days later. So why are we wasting our time? There are better things to do.

David: Going on from there, surely the most interesting thing that has happened in a long time as far as math education is concerned has been the publication of the Cockcroft Report, "Mathematics Counts." This is a result of about three years' work by a government committee.

What is interesting is to trace the history of that committee. Round about 1979 and before, there was growing--apparent growing--public dissatisfaction with the "standards" of school leavers in mathematics. A lot of the criticism was coming from industrialists, employers, politicians, and parents. The result was that the government set up a select committee of inquiry to look into that. And the outcome of that select government committee was to set up a government committee under the chairmanship of Bill Cockcroft to investigate the teaching of mathematics in primary and secondary schools in England and Wales.

The Cockcroft Committee met for 3 years or thereabouts and produced its report in 1982. The significant thing is that the report did not on the whole find any truth in the previous allegations that the mathematics that the employers said kids needed for work was not being covered by teachers, but also they found that a lot of mathematical skills that employers said kids needed for work were not actually needed at all.

Sylvia just talked about fractions. Just to read you a very short paragraph from the section on Employers' Needs from the Cockcroft Report, part of paragraph 75:

"The need to perform operations such as 2/3 + 3/7 does not normally arise." (That is, does not normally arise in industry and employment.) "The manipulation of fractions of the kind which is commonly practiced in the classroom is hardly ever carried out. In the rare instances where it is necessary to multiply or divide fractions, it is usual in industry and employment to convert each to a decimal before performing the operation, if necessary with the help of a calculator."

That's just a small sample. What the report does go on to say is that what is needed and what employers do actually want are children who can think, children who can problem solve, children who can be creative, children who are able to sort out what mathematics is needed and what is not needed and what part of a problem is relevant and what part of the problem isn't relevant, and so forth. What they don't want are a load of slaves and morons who act robotically.

Sylvia: The consequences of that report are beginning to be felt. In my work with five schools in my area, I find that the schools are addressing themselves to the issue of what "basics" they teach and how that is related to other things that they teach in the math curriculum. What use do they make of it? What context is it put in? What else could they do with the time that they used to spend on drumming in trivial facts? What are they not doing that they ought to do? What opportunities are they giving students for problem solving and for thinking activities? All that is certainly filtering its way down into schools.

Tom: Are substantial changes being made, do you think?

Sylvia: I think substantial changes are being made in certain areas, particularly in the production of new curriculum frameworks and assessment schemes.

It will take a long time for teachers to develop new areas of expertise and the confidence to teach in new and more thoughtful ways.

Tom: How one would get a copy of the Cockcroft Report?

David: People could get the actual report from any of Her Majesty's Stationery's Offices in England. The cost of the copy in front of me was 5 pounds 75, which makes it about $8. The Association of Teachers of Mathematics in England has produced a short summary of the Cockcroft Report. It's a very thin pamphlet which costs very little indeed. That may be helpful to people who haven't got the time or the inclination to wade through the 300 odd pages of the original report.

Tom: And ATM's address is King's Chambers, Queens Street, Derby, DE1 3DA, England.

Sylvia: The cost is 75p, which makes it about 90 cents.

Tom: And another 50 cents for postage, perhaps. Can you characterize in a paragraph or two the flavor of the Cockcroft Report?

David: Let me quote from a page in front of me, which deals with estimation and approximation. "Although accuracy is important, so too is the ability to estimate and approximate which helps to insure accuracy especially if a calculator is being used." The report comes down heavily on the side of children's using calculators in the classroom, but enabling them and teaching them and helping them to use them sensibly. That requires a lot more work on estimation and approximation.

Sylvia: I think too that the overall flavor is one of stating very firmly that all teachers should be using a wide range of teaching styles, not just exposition. They should be allowing space for discussion. They should be allowing space for investigative work. They should be allowing space for problem solving work. They should be thinking about pupil-reacher question-and-answer sessions. They firmly state that we should encourage students not just to work with pen and pencil but to use both practical apparatus of the sort that David's talked about and objects like scales and measuring devices.

David: The paragraph that Sylvia just referred to has become famous as paragraph 243. So if anybody's actually looking at the Cockcroft Report, that's the paragraph we're referring to.

Sylvia: One other major strand which I think needs mentioning is that the report heavily comes down on the side of slowing down and reducing the quantity but improving the quality. We need to cut some things out and make sure that kids understand better a smaller amount of work. We shouldn't rush through everything at elementary school, then rush through it all again in secondary school. We should span out our curriculum over the years and not keep repeating things over and over again.

Tom: Very good. Let's invite people to look, to follow up with the full report or the short summary available from the Association of Teachers of Mathematics.

Thanks to David Lingard, who is head of Northcliffe Comprehensive School, near Doncaster, Yorkshire, and to Sylvia Johnson who is research officer for a DES project on low-attaining kids, DES meaning Department of Education and Science, which is similar to our National Institute of Education.

Surely, we should guide children into new paths toward knowledge, but avoid holding their hands too tightly for too long. Otherwise they may fail to understand such knowledge into their own.

Stephen Rowland
The Enquiring Classroom

A SQUARE PEG IN A ROUND HOLE: OR, CAN MATH BE FUN?

Debbie Curry

This summer I took part in the Teacher's Center Seminar on teaching math. At the beginning of the class, I felt like a square peg trying to fit into a round hole. I am a high school teacher and had signed up for what I thought was a secondary education class dealing with teacher competencies. You can imagine my surprise on the first day of class finding myself among a group of teachers where the topic was teaching math. I was horrified. I am a biology teacher. I hate math. All my life, math has been a thorn in my side. I have never been good at it and avoided it at all costs. However, as the week progressed, for the first time I realized that math could be fun. I am writing this paper because I feel that my viewpoint as a math-hater may be of use to other teachers.

All of my memories of past math experiences bring up feelings of frustration, bewilderment, and inadequacy. It seemed that whenever I asked, "Why?", the teacher always said, "That's the way it is. Just memorize it." What seemed like hundreds of homework problems always led to frustration. It always seemed the problems were never like the one the teacher had shown in class. When watching the teacher do the problem on the board, it always made sense. But when I tried to do the problem myself, I never knew where to start. Math texts seemed unreadable or uninteresting. Tests became ego-deflating experiences, since the problems always seemed to have come from another planet. The whole math picture never seemed to fall in place. I was always busy memorizing equations or terms with no idea what they meant or why things were done that way. They had no meaning to me, so I just memorized them to get through the test and then promptly forgot them. You can imagine what that did for my ability to build on concepts.

I eventually struggled through the two years of required high school math by getting good grades on notebooks and projects to offset my bad grades on tests and homework. In college I squeezed through Algebra after taking it two times and passed trigonometry only by the grace of a sympathetic professor.

As Sylvia and David taught the math course this summer, I began to look over my past experiences in math to see what had caused my problems. I came to he conclusion that:

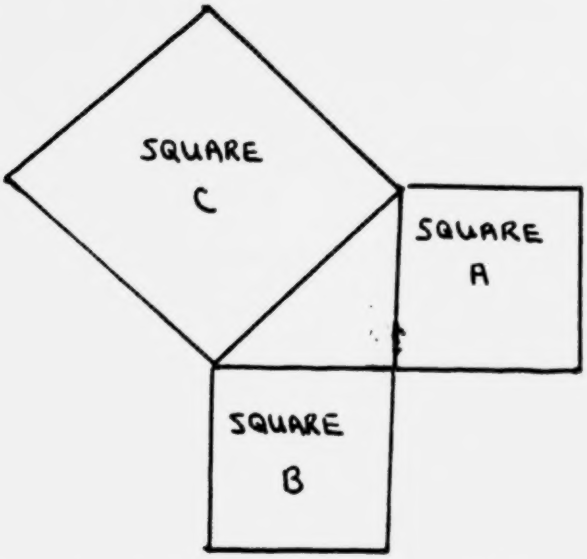
1) As already mentioned, I was always told to memorize, but never really understood what I was memorizing.

2) I never remember a teacher having us play math games. Math class always followed the same format. First, the teacher asked the students if they had any questions about the previous night's homework or had the students put the problems on the board. I never had questions because I usually didn't know enough to formulate a question. Next, the teacher went over the new concept for the day by putting two or three examples on the board. Finally, we were given the rest of the hour to work on our homework assignment. Of course, the teacher stayed at her desk in

case we had questions, but never walked around the room to see if we were actually doing the problems or doing them correctly. Is this format written in stone somewhere?

3) Problems were explained in words or numbers written on the board but not shown in the physical sense or in a way that I could see and touch. The research of Piaget has become very popular in teacher circles in the past few years. I hope his stages of development will convince teachers that students need to see and touch and not just be told that something is true.

This summer, when David explained the Pythagorean Theorem, I understood it for the first time. Before, it had just been an equation that I was told to memorize. David showed us how Pythagoras derived the equation and let us actually do the construction ourselves. We cut out the figures and proved to ourselves that it worked. The theorem states that $a^2 + b^2 = c^2$, or in other words, the area of square A plus the area of square B is equal to the area of square C.



We cut out squares A and B and found that they fit exactly on square C. This makes it so simple to understand. Why didn't anyone ever tell me this before?

This quarter I am working as a graduate assistant with the secondary education student teachers. We have four math teachers in the class. I polled them to see if any of them had ever had the Pythagorean Theorem explained to them this way. None of them ever hadne of the students has a speech problem, but he said that it wouldn't matter because as a math teacher he didn't need to talk very much, just put problems on the board hope that by the end of the quarter they will realize that teaching math involves more that just putting problems on the board.

In summary, I guess I'm writing this to ask math teachers to try to make math come alive for your students. Be innovative and let your students discover and see concrete examples of problems. This summer, after realizing that math can be fun, I thought of all the things I had missed. Best of all though, I feel less like a square peg in a round hole.

I hear, I forget...
I see, I remember...
I do, I understand...
(said to be an old Chinese proverb)

It is very hard to grow and develop around impatient people.

Developing Number Concepts Through Use of the Calendar

Barbara Goldenhersh

In our preschool classroom, we use a calendar, 21"x24" with large numbers on 3"x3" squares which can be attached by velcro. We start our calendar at the beginning of September as our school year begins and are thus able to begin with single digit numbers.

Our approach to using the calendar is this: A child comes up and, using a pointer, points to the numbers starting with day one and continuing to the last number, (yesterday's date). The other children say the number as it is pointed to. This allows for visual observation as opposed to simply rote counting. The child then finds "today's" number from a group which contains the next few numbers and places it in the next space.

We carefully observe the single digit numbers, 1-9, as these days go by. There is usually at least one child with enough number recognition ability to help us get these in the correct order. Counting and looking at these numbers daily allows for fairly good recognition for most of the children.

At this point, we note that we are out of digits. We then discuss with animation the need to "start over". "We need to put a number in front. Let's look at the beginning." Here we observe that the numbers started with one and so we will put a one in front and a zero after it to make ten.

Each day we find the next number by looking back to the 1-9 to find what will come next. After 19, we repeat the process, looking back at the first numbers to determine that we need a two "in front". After repeating this process for 30 and 31 for a couple of months, the children are ready to discuss what would come next. The children soon begin to develop the numbers 40, 50, 60... by looking back to those first numbers and deciding what number would next be placed in front.

Our children, generally 4-5 years of age, have a variety of number familiarity ranging from no number concepts through rote counting and number recognition, all the way to simple mathematical operations. We see a great deal of growth - with many children fully understanding the process, while others are able to respond along with the group allowing them to feel success and still develop a base for future strength and learning in this area. Proof that the children are recognizing the numbers and not just rote counting is the game they begin to play of trying to "trick" the others by pointing to numbers at random. The children find it almost impossible to trick the others.

An additional benefit to this calendar approach is its strong relationship of left to right development. We have seen much progress in this area among children exposed to this daily calendar proceedure.

We use our calendar in many additional ways which further extend number concepts.

1. Put special markers on the calendar such as a pumpkin and count the "empty spaces" to see how many days until Halloween. (use holidays, field trips, special events)

2. Discuss the calendar in terms of what number came before and what comes next.

3. Discuss the idea of yesterday, today, and tomorrow.

4. Count backwards. At the end of the month, the children enjoy counting off the numbers as they are removed in reverse.

5. Remove numbers at random and have children tell what is missing.

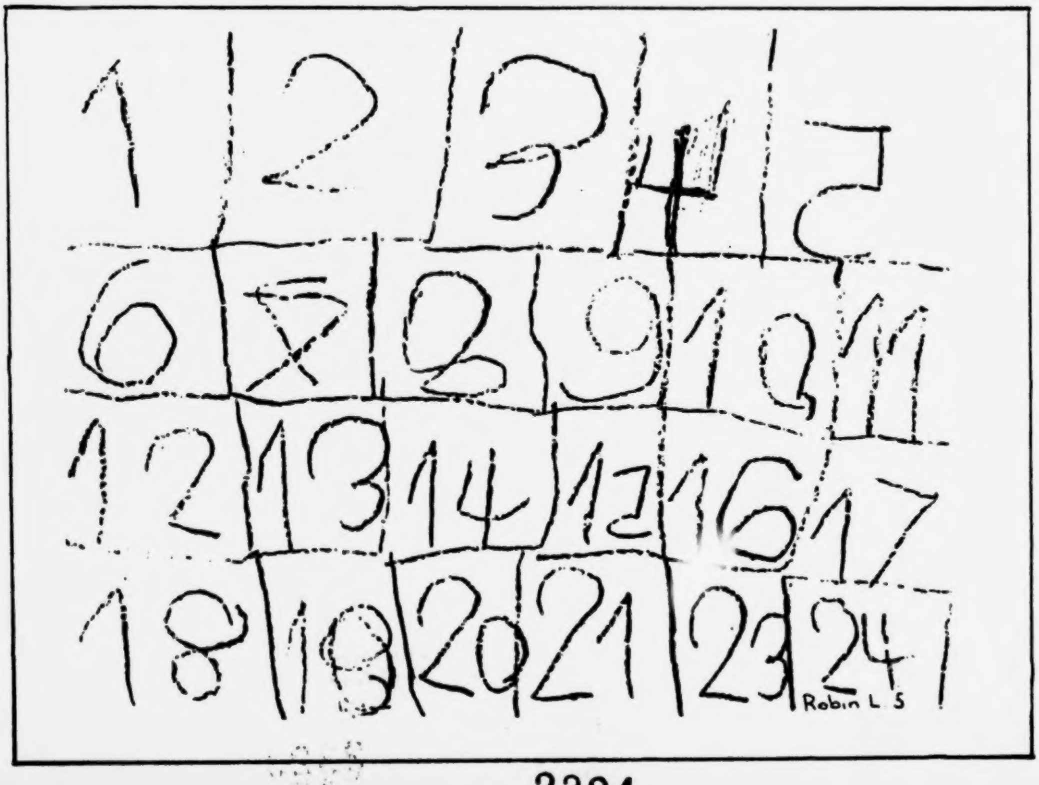
6. Place numbers around calendar at random and have children reorder them.

7. Think of a number and have children guess it. Tell them if it is higher or lower than their guess until they are correct.

8. Make a one hundred chart and have children place chips on the numbers as they say them.

9. Use the chart or calendar to count by 10's, 5's, 2's, 3's, etc.

What ideas can you invent?

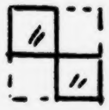


SQUARES, CORNERS AND LEAST POSSIBLE AREA

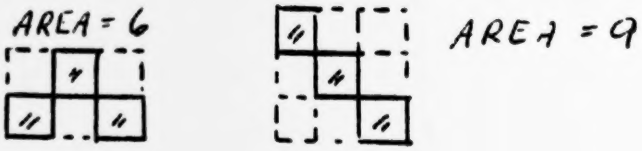
Joyce Bishop

The problem presented to a group of teachers in workshop began with two squares of equal size joined corner to corner at 90° in the same plane. As a group, we soon discovered that two squares could be enclosed in a square with the least possible area of 4, in one possible arrangement, one possible area. (1)

(1)



(2)



Three squares yielded two different arrangements and two different areas. (2) Four squares had five different arrangements, not counting rotations and reflections, and four possible areas. Then we broke into smaller groups to investigate the question: What is the maximum and minimum enclosing area for any number of squares?

For a while, I found myself more interested in discovering all the possible arrangements for each number of squares. I needed a sense of having considered all the possibilities before I could state with confidence the maximum and minimum area for a specific number of squares.

Working in small groups and then regrouping, we soon developed a table.

(3)

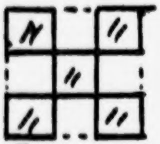
Squares (n)	ways	minimum area	maximum area
2	1	4	4
3	2	6	9
4	5	8	16
5	12(?)	9	25

At first it looked like a simple pattern was emerging for both minimum area and maximum area: min. area = 2n and max. area = n2. The maximum areas could be found by arranging all he squares in a diagonal pattern, and we were soon satisfied that this would always yield a maximum area of n2. Not so with our formula for minimum area. Five squares was only the first exception. Others followed. (4)

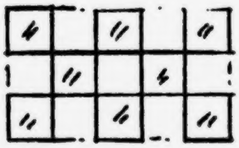
(4)	no. of squares (n)	min. area		no. of squares (n)	min. area
	6	12	*	13	25
	7	14	*	14	27
*	8	15		15	30
	9	18		16	32
	10	20	*	17	33
*	11	21	*	18	35

We thought we could predict that every third one would be an exception to the rule, and thus arrive at a new rule, but #13 proved the error of that line of thought.

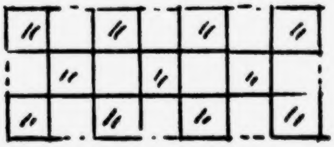
One participant at our table commented that the irregular numbers (where the minimum area was not equal to 2n) always seemed to fill up the four corners, whereas other arrangemnts of the same number of squares did not. (5)



5 squares
min. area = 9



8 squares
min area = 15



11 squares
min area = 21

This led me to look at the dimensions of the minimum area arrangements, and I added a column to my table. (6) I started writing the dimensions in pairs, but since some had more than one possibility, I soon switched to factoring the areas down to prime numbers. One of the first facts this procedure brought to light was that 2 was never a factor of the irregular areas.

At this point I was convinced that the answer was a product of the form (n + ?) (n + ?), and I tried to make up a formula for each minimum area in hopes that I would stumble onto one that would fit all cases. Even the formula n2 - (n - 1)2 boiled down to 2n - 1. How could I tell when to use 2n and when to use 2n - 1?

The idea about the exceptions filling the corners came back into focus about now. It seemed that combinations of multiples of 3 and 5 had a tidy way of using all corners without the odd one left over to start a whole new column of squares and thus add to the area.

So I began to rewrite each no. of squares as a sum of multiples of 3 and multiples of 5. The new chart looked like this: (7)

no.	min. area	(6) dim. of area	(7) no. of squares as a sum of 3's and 5's	
2	4	2x2	2	
3	6	2x3	3	
4	8	2x2x2	4	
5	9	3x3	5	*
6	12	2x2x3	5+1	
7	14	2x7	5+2	
8	15	3x5	5+3	*
9	18	2x3x3	5+4	
10	20	2x2x5	5+5	
11	21	3x7	5+6	*
12	24	2x2x2x3	5+7	
13	25	5x5	10+3	*
14	27	3x3x3	5+9	*
15	30	2x3x5	10+5	*
16	32	2x2x2x2x2	10+6	?
17	33	3x11	5+12	*
18	35	5x7		

Only the irregulars could be written in this form until I got to 16. But sixteen could be written as a sum of 10 and 6. Why wouldn't it fit into a grid of area 2n - 1 or 31? Because 31 was prime and would not be divided by any pair of numbers other than 1, 31. That pair would not allow the corners of the squares to touch, one of the original conditions. Was the condition of prime or not prime a key consideration?

Indeed it was. A quick check verified that when 2n-1 was prime, the least area would be 2n, and when 2n-1 was not prime, least area would be 2n-1. This was the generalization for which I had been searching.

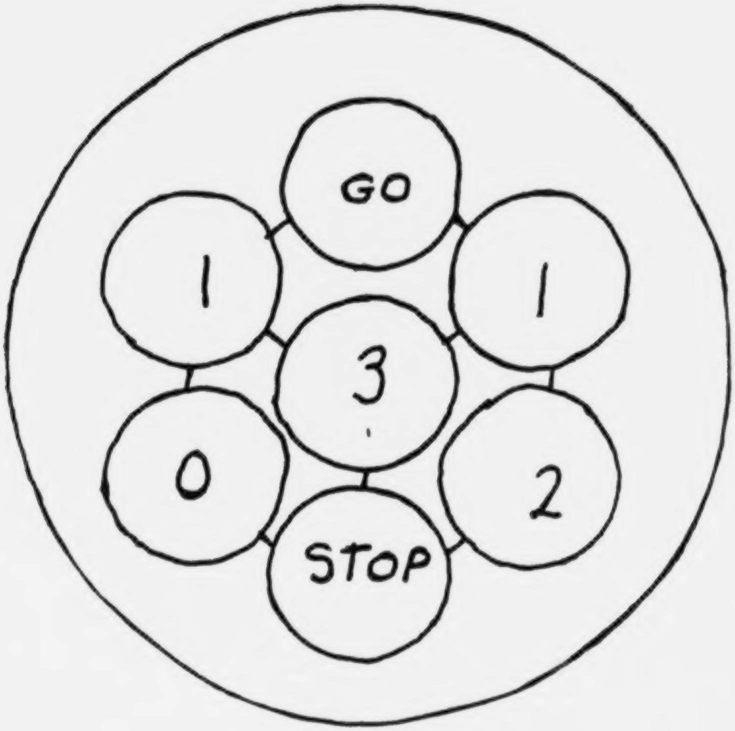
In the early stages, it was a great help to work in a group and be able to compare findings. The remark of one of my group-mates triggered the investigation that eventually led to a resolution. However, it took two separate work sessions after class time on two different evenings to get results. The concept of prime numbers had been involved for some time, but I did not immediately see how it fit into the final solution. It is clear though, that an investigation that doesn't lead directly to the answer may still yield something useful.

The child is not GOING to be somebody.
The child already IS somebody.
Emsy Dunn

GO GO GO I

Virginia Small

Here is a super game I tried with my first graders. The object of the game is to start at Go and as you pass through a circle add the number to your growing total. A circle can be passed through only once. This has great possibilities for problem solving. What is the smallest number you can have? What is the largest number you can possibly have? How many different ways can you find having the same total?



TIC TAC DOMINO

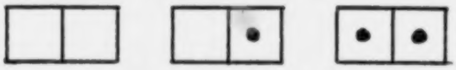
Julie Wilcox

Hoping to keep the spirit of the summer math course alive, I decided to introduce an activity that could have the possibility of creating many intertwining events.

Though dominoes have been around for many years, I wasn't aware of the multitude of mathematical learning that can take place. Many different domino activities were presented in our class. I decided to take a few of the ideas and experiment with my eighth grade math class.

To begin this activity I asked the students if they had ever worked with dominoes before. Everyone's reply was positive. Next I asked how many students knew how to play one or more domino games. Not surprising to me, only about five of the twenty-two students could explain a game. Most of the students had used the dominoes as building blocks. (This is a good way to work with set notation.)

Using material from class, I decided to challenge the students with an activity that would familiarize the class with the different types of dominoes in a set. On the board I drew a Double-One Set.

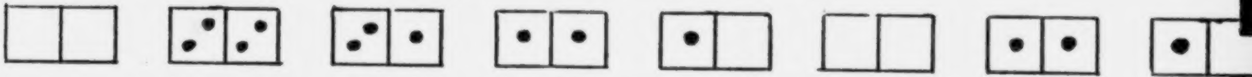


We discussed the three dominoes that make up the Double-One Set.

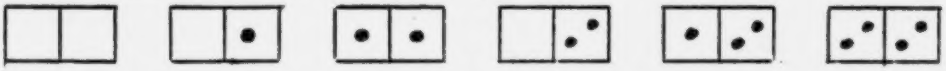
Next I asked the students how many dominoes in a Double-Two Set. Most of the students used paper and pencil to sketch out the domino arrangements. The class came up with two different arrangements for the number of dominoes in a Double-Two Set.

Below are the two different arrangments for the number of dominoes in a Double-Two set.

A. These students said that there were eight dominoes for the Double-Two Set. They repeated three of the same dominoes. They drew two double blanks, two blank/ones and two double ones.



B. About ten students suggested that only six dominoes would make up the Double-Two Set. They said that it didn't seem to make much sense in having more than one kind of domino per set.



After experimenting with the Double-Two set, I explained to the class that there were six dominoes in a Double-Two set. I asked the students to try this activity overnight and see if they could find how many dominoes would be in Double- Three, Four, Five, and Six set 5.

The next day about three-fourths of the class had solved the activity by sketching out the Double Sets on paper. Several students called my attention to a pattern that could be used to find out the number of dominoes in a set without drawing them out on paper.

Number of Double Set	Number of Dominoes	
Double-One Set	3	
		+ 3
Double-Two Set	6	
		+ 4
Double-Three Set	10	
		+ 5
Double-Four Set	15	
		+ 6
Double-Five Set	21	
		+ 7
Double-Six Set	28	

After experimenting with the above activity for a couple of class periods, I decided to present a domino activity that involved working with a grid. This activity was also shown to our class. I'll call this game Tic Tac Domino.

The rules of the game are to place the given dominoes on the pre-numbered grid, so that they will all fit in a proper spot. Below is the grid that was used, and the given dominoes.

5	2	5	5
3	1	1	5
1	5	0	5
1	0	0	0

Use only these dominoes.
2-5, 5-0, 0-0, 1-1, 1-0, 5-1, 5-5, 5-3

Students used a variety of methods to figure out this activity. From using paper and pencil to making their own dominoes or using a set of dominoes the students experimented eagerly.

About half of the class solved the problem. I asked them what methods they used to complete the grid with the correct dominoes. They stated that they knew that there was just one place to put the Five-Three domino. Next they said that there were three places that the Double-Five could be placed. From there on the rest of the game was trial and error.

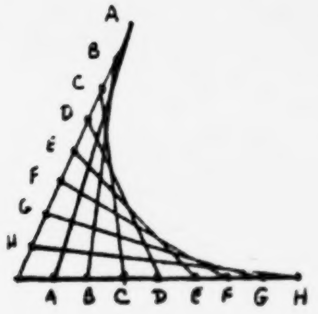
I asked the students to see if they could make a new arrangement on a different size grid. The next day several students had made grids ranging from a six by six, to a six by seven, to a seven by eight. Pleased with their work, I asked them how they had arrived at their grids. Two of the students used dominoes to arrange a square or rectangle and then they copied down the dominoes that were used. The other student drew out a grid and then, by means of trial and error, placed different dominoes on the grid.

STRING ART TESSELATIONS

Karen Riess

While browsing through some of the math reference books I keep in my room, a student became engrossed in the word "tesselation". He decided from his research that tesselations are "when polygons fit together exactly. Each side has to line up and there can be no gaps". The student began to investigate by cutting cardboard shapes, tracing them, arranging them, and studying the results. His excitement soon spread to other students and a great deal of exchanging of ideas and comparing of sketches started taking place. "Look. Mine can be made into the same shape, just bigger." "Mine won't do that. In fact, his pentagon just won't fit right at all." "I started out with a triangle and got a trapezoid." "I started out with a triangle, too, but I'm getting a hexagon."

The longer the students worked, the more comments I began hearing about how beautiful the designs were. One of them finally suggested filling the various angles with lines using a process that the students call "string art". After each side of an angle is divided into an equal number of parts, corresponding points are connected so that straight lines start to give the illusion of a curve. (We had worked with this concept earlier in the year.) These lines are then stitched onto posterboard, thus the name string art.



The group decided that each string art project should be accompanied by a written report. Each report was to include a description and drawing of the original polygon, the outline of the basic tesselation before the string lines were drawn, and a sketch of the finished project (just in case the real artwork didn't turn out well, they had proof that it could have worked). Final projects were submitted on posterboard, wood, and even as a three-dimensional pyramid. The results were beautiful and are to be displayed at the school's annual fine arts fair.

DICE GAME
Stephen R. Boyer

A number of activities presented to students involved the use of dice. The first activity involved three rolls of the die. Students were directed to attempt to make the largest three digit number possible. After each roll of the die, the student had to decide where to place the number. Points were awarded according to how big the student's number was. This activity was done with both fourth and eighth graders. Both groups felt that this activity was easy and presented very little challenge. The fourth graders, however, were more serious and interested in this activity. Both groups were extremely successful and seemed to understand place value.

The next activity involved trying to form a number as close as possible to 325. Again, the die was rolled three times. After each roll, students had to decide in which place to put the number. Students kept score by finding the difference between their number and 325. The eighth graders continued to find this activity easy, but they challenged one another to see who had the best score. The fourth graders were very interested in the numbers that appeared on the die. They expressed their displeasure and their happiness with "oohs" and "ahhs."

The next activity involved making a true statement in the following form: ☐☐☐ < ☐☐☐ and ☐☐☐ < ☐☐☐ < ☐☐☐. The die was thrown and students had to decide where to place each number. The eighth graders were almost all successful. Students who were unsuccessful voiced their disappointment. The fourth grade openly expressed their successes and failures, constantly showing their papers to me. They did not seem to have a great deal of difficulty in understanding the activity.

The next activity involved rolling the die five times. Given the following configuration: $\begin{array}{r} \square\square \\ -\square\square \\ \hline \end{array}$, students were to arrange the numbers in the boxes. They were to try making the smallest number possible on top and the biggest number possible on the bottom. The difference between the two numbers was the student's score. The smallest scores won. The eighth grade stated that it was hard to decide where to place the numbers. They were very frustrated at times with the number that appeared on the die. This was the first activity that seemed to seriously challenge the eighth grade. The fourth grade understood the rule, but they were not so serious about the activity. Their main concern was to try to subract the two numbers correctly. Some students asked for my assistance in helping them figure out their score.

The final activity involved a grid such as the following:

	10	16	35	
12				
6				
18				

The numbers along the top and the side of the grid were given to the students. A die was thrown nine times to complete the inside of the grid. After each throw of the die, the student tried to place the number in a position in which the number would divide into the given number along the top and the side of the grid. A total of eighteen points was possible. One point was awarded each time the number divided into the given number at the top or side of the column.

The fourth grade students did not understand this activity because they were not proficient enough at division. The eighth graders were interested in the activity and were concerned with fitting the numbers into the best spaces.

This activity was repeated with the eighth-grade students, but allowing them to choose their own numbers to complete the grid. They found this somewhat easier. Most were able to score seventeen out of eighteen possible points.

"When we plant a rose seed in the earth, we notice that it is small, but we do not criticize it as 'rootless and stemless'. We treat it as a seed giving it the water and nourishment required of a seed. When it first shoots up out of the earth, we don't condemn it as immature and underdeveloped; nor do we criticize the buds for not being open when they appear. We stand in wonder at the process taking place and give the plant the care it needs at each stage of its development. The rose is a rose from the time it is a seed to the time it dies. Within it, at all times, it contains its whole potential. It seems to be constantly in the process of change; yet at each state, at each moment, it is perfectly all right as it is."

Timothy Gallway
The Inner Game of Tennis

SUMS

Judy Hall

(An activity introduced by Johnson and Lingard)

This activity was quite helpful at the beginning of the school year when I needed an activity to restimulate my third graders' minds to add and subtract. I suggested a number -14- and asked the class to generate as many problems as they could to attain 14, writing them on the board as they were suggested:

9 + 5
10 + 4
7 + 7
12 + 2
6 + 8
8 + 6

"Aha., Miss Hall. We already have that problem."

"Do we?" I asked. After which a discussion ensued, wherein we all agreed it was the same problem and could not use it again. We continued:

13 + 1
0 + 14
3 + 11
7 x 2

"Wait. You didn't add. Can we count this?" I asked. After another meaningful discussion, the class decided that any problem using any sign was acceptable. So, we continued.

2 x 7 "Oops, same problem-No go." the class remarked.

14 x 1 "That's all, Miss Hall. (Note: no divisions were suggested because they had not yet been formally made aware of it).

At this point, I informed the class they would be given their 'own' number and were to generate as many problems as they were able. There were no rules. Everything counted as long as it equaled their number. They would have one week.

When the week was over, I covered our one blackboard with shelf paper and then sectioned it off so that each child would have a space to list their problems. Each child had several days to list as many of his problems as he could. Then we had a discussion of what they found out while generating their problems.

It was interesting to see the routes various children took to get to their numbers:

1. Chains: 7 - 6 + 5 - 1 - 7 x 2 (to get 14)
2. Some only added 2 digit numbers or only 3 digit numbers, etc...
3. Infinity approach -- 1,000,000 - 999,986 (to get 4)
4. Some only generated simple additions and then quit (as we did on our example).

The closing discussion was quite profitable for the kids as well as for me. Some discoveries mentioned were:

You could go on forever. (Hence the title "infinity approach")

Some people added, subtracted or multiplied wrong and therefore did not have as many problems as they thought.

Answers for littler targets (7 or 9) were easier to work with than larger numbers (26 or 42).

Calculators were very handy.

Once the discussion came to a close, the piece of shelf paper was displayed in the hallway along with photos I had taken during the activity. After a week, we brought the display back into our room and placed it permanently on the wall above the lockers.

This spot is the beginning of a new place in our room called 'BRIGHT IDEAS'.

BACK TO THE START

Barb Hill

Here is an interesting activity that involves patterns. You will need red and blue bingo chips (enough for each student to have six of each color).

Start off with a simple pattern (ie: two red chips side by side) and pose this question: How many moves will it take to get back to the same patttern (two red chips) if you have to remove a chip from the right and put back the opposite colored chip (blue) on the left side?

We set up a table like this:

PATTERN	MOVES
rr	4
rb	4
rbr	2

After working the possible patterns with two chips (rr, rb, br, bb), we tried three chips. By now the students were guessing at the number of moves. They posed the theory that if you double the number of chips you are using, you will come up with the number of moves it takes to get back to the original pattern.

I set up a pattern like this: rbr and asked, "How many moves does it take when you alternate my colors?" Before working the actual moves, the students decided it would take six moves. This time, however, it only took two moves. Now they were puzzled because their theory did not work. I added another chip so the pattern was rbrb and asked the same question. This took eight moves. We worked out several other patterns:

rbrbr
rrbbrbbr
rbrbbrr

These are just a few of many. The children came up with lots of conclusions, but to share them here would be to spoil things for you. What can you find out? What can your students find?

POLYA

If Euclid failed to kindle your youthful enthusiasm, then you were not born to be a scientific thinker.

Albert Einstein

ELEMENTARY SCHOOL MATH

Mary Anne Jennings

My ten junior high students have been on individualized learning packets, so any break from that routine sounds exciting to them. I told them we were going to play a game. One response was, "A fun game or work game?"

I explained that the game is called "Counting to Forty." You need a partner, a piece of paper, and a pencil. The rules are very simple:

1. Start with the number 6.
2. You may add either 1, 2, 3, or 4.
3. Alternate turns with your opponent.
4. The first person to reach 40 wins.

The students paired off and began playing the game. They continued to play, a different player taking the first turn each time.

After three games many had decided that all you had to do to be a winner was be the first player. We only had one exception to this rule so far.

We continued to play until they could come up with some pattern that would guarantee a win. Some realized that the person who got to 35 first could always win the game. Others thought possibly you could put 4 down every time except the last turn, when you would use the number you needed to beat your opponent.

They played a couple more games but still no one had an answer for the question, "How could I be sure to win this game no matter what my opponent put down?" After I had asked that question several times and made it clear to the students that there was a way, they challenged me to play a game and prove I could win.

My opponent played first and this is the progression that followed:

Start	6
Brent	10
Me	11
Brent	13
Me	15
Brent	16
Me	20
Brent	22
Me	25
Brent	27
Me	30
Brent	34
Me	35
Brent	38
Me	40

I asked them, "Now how did I win?" Can you see from the numbers here how I beat Brent?"

First, they counted off the numbers such as: up 1, up 2, up 3, up 3, up 1, up 2. they could not see a pattern there and that stumped them.

I encouraged them again to look at my choice of numbers. An eighth grader finally saw the numbers I had chosen were the multiples of five.

This was a great way to stimulate thinking in this group. Some didn't think they were smart enough to figure out this hard problem, but when they saw there was a simple answer, they realized any one of them should have been able to reason the problem through.

I enjoyed using this type of problem-solving game with my students because it encourages them to have fun with math. No idea is a bad idea when you let students brain-storm in solving problems. It is great for slower students to realize they have as much chance to figure out answers as do brighter students. Try it with your kids.

POLYA

Thus all human cognition begins with intuitions, proceeds from thence to conceptions, and ends with ideas.

Kant

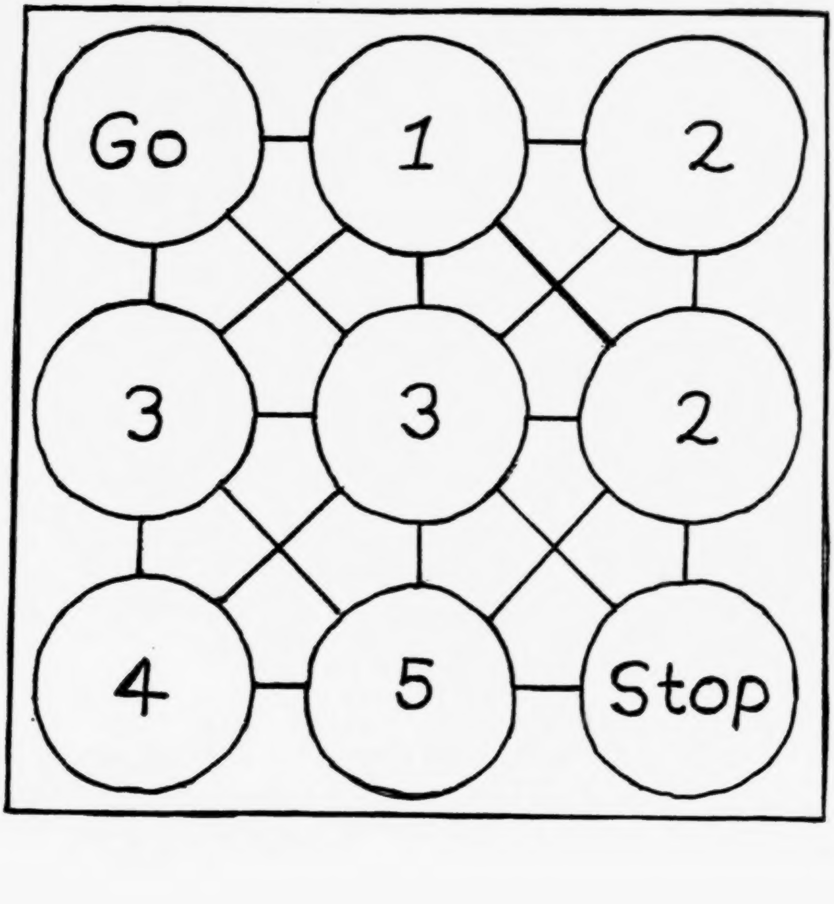
(Learning begins with action and perception, proceeds from there to words and concepts, and should end in desirable mental habits.)

An average four year old child asks 437 questions a day.

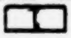
GO GO GO II

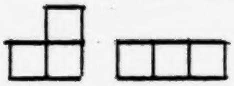
Virginia Small

Here is another problem solving puzzle I used with my first graders. They were so excited about working out solutions they wanted to skip break time. What is the smallest possible number you can find? What is the largest possible number? Is it possible to use all the numbers? How many different ways can you find your total?

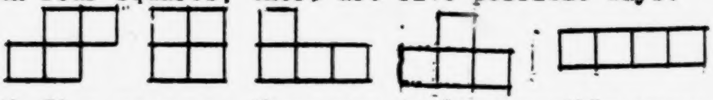


Squares
Stephen R. Boyer

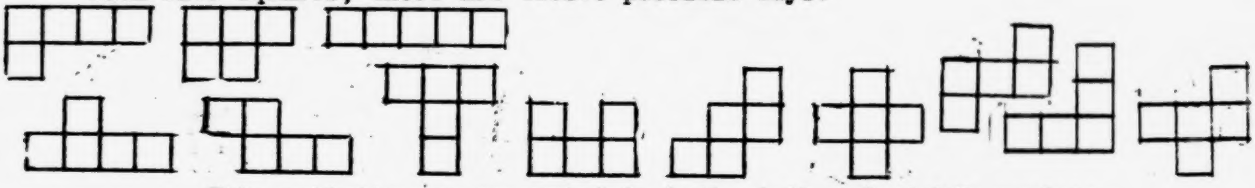
The activity presented to students involved arranging squares into patterns. First, students were directed to draw a group of squares with the complete length of one side touching the complete length of another square. Students were directed to find all the possible combinations with two squares. Students were then shown there was only one way to arrange two squares with a side touching (). Students were asked to repeat the activity with three and four squares. When using three squares, there are two possible ways:



With four squares, there are five possible ways:



With five squares, there are twelve possible ways:



This activity was presented to both sixth and eighth graders. All the sixth graders easily saw that there was only one way of arranging two squares side by side. Some sixth-grade students could only find a few ways to arrange three, four, or five squares into patterns. Some sixth grade students were reluctant to draw the patterns on their paper, but tried to visualize the possible patterns without drawing them. After most students had drawn five or six patterns wih five squares, they felt they had drawn all the possibilities. Students were surprised there were twelve possible patterns using five squares. One student was able to find eleven different patterns in just a few minutes.

The eighth graders, however, had trouble seeing there was only one possible arrangement for two squares. They believed there were four possible combinations. After they were shown that these four patterns are identical, however, they were able to grasp there is only one possible pattern. The eighth-grade students were able to develop more patterns than the sixth graders. Most eighth-grade students were able to draw at least seven or eight patterns for the five squares. One student was able to draw all twelve patterns.

The students were next given a piece of graph paper with seventy one-inch squares. Students were directed to attempt to draw all twelve patterns on the single sheet of graph pater. Both sixth and eighth-grade students had a great deal of difficulty fitting the twelve patterns on the graph paper. Only a few students from each class were able to complete the activity successfully.

Next, students were asked to cut out the patterns and try to arrange them into a rectangle. Students in both the sixth and eighth grades were not able to successfully complete the rectangle. Both grades believed it was not possible to form a rectangle. All students were frustrated at this point. Overall, students were enthusiastic and were challenged by this activity.

POLYA

Mathematics is the science that yields the best opportunity to observe the working of the mind... and has the advantage that by cultivating it we may acquire the habit of a method of reasoning which can be applied afterwards to the study of any subject and can guide us in the pursuit of life's object.

Condorcet

(Commenting on Euler's work.)

POLYA

...we should give no small share of the credit to Democritus who was the first to state the result though he did not prove it (just guessed it). The method I used did not furnish an actual demonstration (just a suggestion, a guess. ... Yet) I foresee that this method, once understood, will be used to discover other theorems which have not yet occurred to me, by other mathematicians, now living or yet unborn.

Archimedes

(First guess, then prove - that's the way to do it.)

FACTORING

Sonya Baker-Preston

In August 1984, I had the pleasure of being a part of the Teacher's Center Project along with David and Sylvia, two math teachers from England. David and Sylvia shared math experiences and ideas with us, and I decided to incorporate some of their enrichment exercises into my class, which consists of two groups of 10 incarcerated males, ages 12-17.

I asked the class to draw a large square on their paper and divide it into 5 rows of 5. At this point, I asked how many squares would be on the paper. (Answer 25). I drew an example along with the students to reduce confusion. I then showed them 6 squares where they were to put any 6 numbers between 1 and 100. (See below). During this time we had a discussion on the word "between." (Does it or doesn't it mean to include the numbers 1 and 100). While the students were choosing their numbers, they discussed the numbers they chose. Most numbers were birthdays, girlfriend's birthdays or the day they met their girlfriend. After they chose their numbers, we were ready to begin the activity. A grid would look similar to the one below.

	2	15	19	
32				
4				
20				

Next, I would roll one die and call out the number I rolled. The students are to put the number somewhere on their grid where it can be evenly divided into the numbers they have chosen. If the number can be place where it can divide into two of the previous numbers, this is a good place to put it. If it divides into one number, that's okay, too. If there are no numbers, the rolled number must still be placed somewhere on the grid. See example below.

	2	15	19	
32		3		
4	2			
20				

1. Roll #1 was a 2. A good place for the 2 would be where the 2 and 4 meet, because 2 divides into 2 and 2 divides ito 4 evenly. (There are 2 other places to put the 2).
2. Roll #2 was a 3. The best place for it would be where the 15 and 32 meet. Although 3 doesn't divide evenly into 32, you'll still get 1 point for the 15.

After 9 rolls, your grid might look something like this:

	2	15	19	
32	2	3	6	
4	2	1	4	
20	4	5	6	

At this time, you are ready to add up your points. You take each roll individually and ask yourself if the roll can be evenly divided into your numbers. For example:

Start here	
2 goes into 32	1 point
3 doesn't go into 32 evenly	0 points
6 doesn't go into 32 evenly	0 points
Total	1 point
Then :	
2 goes into 4	1 point
1 goes into 4	1 point
4 goes into 4	1 point
Total	3 points
Third Row:	
4 goes into 20	1 point
5 goes into 20	1 point
6 doesn't	0 point
Total	2 points

	2	15	19	
32	2	3	6	1pt
4	2	1	4	3pt
20	4	5	6	2pt

Now do the columns the same way. Your score for the example grid should be 2,3,0. Add up your total points and write the total in the lower right square.

	2	15	19	
32	2	3	6	1pt.
4	2	1	4	3pt.
20	4	5	6	2pt.
	2pt	3pt	0pt	11

At this point I asked, "What was the highest score possible?" After several guesses and explanations, someone said, "18", which is the correct answer. There are lost of nice questions to ask during this activity and lots of neat answers to get from the students. For instance: What 6 numbers would be the best to choose? Why? I received answers like even numbers, big numbers, etc.
My response was, "Okay, let's try them."

We did the activity together twice. Then I left them on their own. I gave them the die and watched them take on the challenge. Minds were working, and working relationships were built. Later students would say they had the right numbers. So, we'd try again. Their scores were higher, around 15 or 16. I'd say, "Do you have the BEST numbers?" The students were asking each other questions. "How do I find a number that 1-6 go into?", "How'd you get that?" The activity lasted for 2-3 days. After they were sure they had the best numbers, we'd play some more to make sure. We talked about when their solutions wouldn't work. I asked them to write down their strategy, and when it wouldn't work.

In summary, this is an excellent activity. It provides motivation, builds relationships, allows room for thinking, all things necessary for everyday living. It, also gives the teacher an opportunity to introduce new concepts not to say anything of the important roles of 1) probablity and 2) planning ahead.

POLYA

Intuition is the conception of an attentive mind, so clear, so distinct, and so effortless that we cannot doubt what we have so conceived.
Descartes

(Beauty in mathematics is seeing the truth without effort.)

Which Goals Are Basic To Survival?

Alice Powell

As a future teacher, I am concerned with the "back-to basics movement". The following excerpt is from "The Piaget Primer" by Ed Labinowicz. This excerpt gives Piagets' opinion on the "back-to basics movement" and future goals for education.

"Everyone agrees that children should learn what is basic to their survival, but not everyone agrees on what is basic. Many people are concerned that children, by the time they graduate, have sufficient literacy to read a bus timetable and enough math to make correct change or to balance a checkbook. Some of these people also are concerned with children's retention of basic American values such as honesty and good citizenship. In a climate of change, they are seeking the security of their traditions. Those people who are most concerned with passing on their culture, intact, form the backbone of the "back-to-basics movement".

Piaget, on the other hand, speaks out for an education that is not only basic to the potential of all humans, but also ensures the quality of their survival:

> The principal goal of education is to create men who are capable of doing new things, not simply repeating what other generations have done--men who are creative, inventive and discoverers.
>
> The second goal of education is to form minds that can be critical, can verify, and not accept everything they are offered. The great danger today is of slogans, collective opinions, ready-made trends of thought. We have to be able to resist individually, to criticize, to distinguish between what is proven and what is not. So we need pupils who are active, who learn early to find out by themselves, who learn early to tell what is verifiable and what is simply the first idea to come to them.

"Attainment of that goal would equip individuals to make intelligent decisions as voters and consumers by providing them with a vision beyond day-to-day survival. Citizens would have personal standards for judging the truth of advertising claims and the claims of political leaders. Consumers and voters, operating from a critical framework, could detect those needs artificially created by big business and the advertising media, and resist such forms of manipulation. Furthermore, Piaget's goal is directed towards learning how to learn and continuing this developmnt beyond the classroom, throughout life."

AN OBSERVATION OF CHILDREN'S INTELLECTUAL DEVELOPMENT

Ed Rensing

The purpose of this project was to observe children's thinking and development at different grade levels. Thirty students were observed: five each from grades one through six during the first week of December. Two tasks were asked of these students.

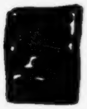
Task #1

The purpose of this task was to determine when children begin to develop the skill of conservation of a liquid, that is, when does a child understand that the quantity of a liquid does not change when poured from a short, thin glass into a tall, stout glass. Usually young children judge the quantity of water by the water level of the glass and not by its shape or size.

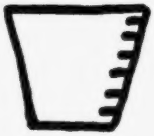
PROCEDURE:

The student was presented with two glasses both different in size and shape. The smaller glass was filled to the rim with water while the larger glass remained empty. It was the task of the child to fill the empty glass with the same amount of water as the smaller glass. The child did not know what the markings on the glasses meant nor that the larger glass could hold approximately twice the amount of water as the smaller glass.

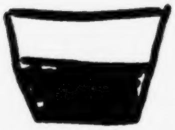
Glass filled
with water.



Empty glass
with markings.



Glass holding
same amount
of water.



RESULTS:

Upon evaluating the results of each of the students, a trend becomes evident. Most of the students in Grades 1 and 2 could not estimate the amount of water necessary to equal the amount in the smaller filled glass. These students usually filled the larger glass to the rim just as the smaller glass was filled, even though the size and shape of the glasses were quite obviously different.

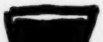
In Grades 3 and 4 more students were accurate or closer to being accurate than in Grades 1 and 2. This trend is even more predominant in Grades 5 and 6. (See Table #1)

This observation leads me to believe that students begin understanding the skill of conservation of water sometime during the third grade and that the skill is sharpened as the child grows older. Upon further observation, one will also notice that two students, one from Grade 1 and one from Grade 2, were able to estimate accurately indicating these two children had begun developing this skill at a much younger age. The results also indicate that the students in Grades 5 and 6 have become much more accurate in their quantitative estimation.

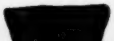
Table #1

Grade 1

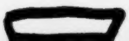
Katie



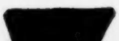
Lori



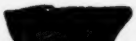
Becky



Jill



Cheryl

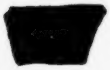


Grade 2

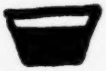
Jasmine

Doug

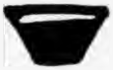
Jennifer



Kora



Jason



Grade 3

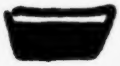
Jamie

Laura

Herk

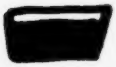
Christie

Heather



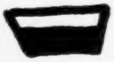
Grade 4

Kevin S.

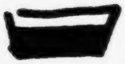


Kevin H.

Craig



Kevin K.



Michelle

Grade 5

Terry

Kristie

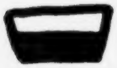
Clay

Jeff

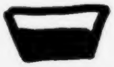
Lisa

Grade 6

Brian



Tracy



Rodney

Michelle

Kate

Task #2

The purpose of this task was to determine when children begin to develop different approaches to finding a sum, that is, when does a child stop counting and begin to add and when does a child move from addition to multiplication.

PROCEDURE:

Each child was given 24 slips of paper (one inch x one inch) and was told to organize them into a pattern for easy counting.

RESULTS:

The results from this task indicate that students do develop different approaches of counting as they grow older. In Grade 1 most students created a random arrangement of rows and had difficulty counting the pieces of paper to arrive at a total. Several were not sure of the task and two who did count the pieces of paper were inaccurate.

In Grade 2 the patterns created were much more conducive to easy counting but only two students were accurate. As in Grade 1 each student had to count every individual piece to arrive at a total.

The students in Grade 3 created patterns for easy recognition much more readily than the younger students; they were much more accurate in arriving at their totals and also displayed an ability for adding with numbers larger than one: e.g., 8+8+8=24; 12+12=24. It must be stated that these students had not yet been formally introduced to multiplication.

In Grade 4 some students still arrived at the answer through addition just as the students Grade 3 had done. However, two students arrived at their totals through multiplication indicating that they had moved beyond addition as the only or the most effective operation for solving this problem.

In Grade 5 two students arrived at the total by adding, but three students used multiplicaion, and in Grade 6, four students multiplied while one student counted each piece individually.

Based upon these results, it does become evident that a child develops a skill from simple counting to a higher operative as he/she grows older. For some students the skills develop earlier or later than for other students. However, by the third grade more students prefer addition to counting and by the fifth grade more students prefer multiplying.

Table #2
Grade 1

Cheryl
X X X X X X X X
X X X X X X X X
X X X X X X X X

Didn't know the total.

Jill
X X X X X X X X
X X X X X X
X X X X X X X
X X X

Didn't know the answer.

Lori
X X X X X X X X X X X
X X X X
X X X X X
X X X X

Said the total was 25.

Becky
X X X X X X X X X X X X
X X X X X X X X X X X X

Didn't know the answer.

Katie
X X X X X X X X
X X X X X X X X X X X X X X X X

Said the answer was 25.

Grade 2

Jasmine
X X X X X
X X X X X
X X X X
X X X X
X X X X

Counted each one for a total of 25.

Doug
X X X X X X
X X X X X X
X X X X X X
X X X X X X

Counted each one for a total of 26.

Jason C.
X X X X X X X X
X X X X X X X
X X X X X X X
X X X X X X

Counted each one for a total of 24.

Jennifer
X X X X X X
X X X X X X
X X X X X X
X X X X X X

Counted each one for a total of 24.

Kari
X X X X X X
X X X X X X
X X X X X X
X X X X X X

Counted each one for a total of 23.

Grade 3

Heather
X X X X X X X X
X X X X X X X X
X X X X X X X X

Counted each one
for a total of 24.

Christie
X X X X X X X X
X X X X X X X X
X X X X X X X X

Counted 8+8+8=24.

Jamie
X X X X X X X X
X X X X X X X X
X X X X X X X X

Counted each one
for a total of 24.

Laura
X X X X X X X X X X X X
X X X X X X X X X X X X

Said 12+12=24.

Herk
X X X X X X X X X X X X
X X X X X X X X X X X X

Counted twelve twice and
then said 24.

Grade 4

Craig
X X X
X X X
X X X
X X X
X X X
X X X
X X X
X X X

There is the
same number in
each row. So
3x8=24.

Kevin
X X X X X X
X X X X X X
X X X X X X
X X X X X X

Four rows of
six equals 24.

Kevin S.
X X X
X X X
X X X
X X X
X X X
X X X
X X X
X X X

Added the
three columns
of eight.
8+8+8=24

Michelle
X X X X
X X X X
X X X X
X X X X
X X X X
X X X X

Added the rows
together.
4+4+4+12=24.

Kevin K.
X X
X X
X X
X X
X X
X X
X X
X X
X X
X X
X X
X X

Counted by 2's for a total of 24.

Grade 5

Michelle

X X X X X X X X
X X X X X X X X
X X X X X X X X

Said 3x8=24.

Robyn

X X X X
X X X X
X X X X
X X X X
X X X X
X X X X

Said 4x6=24.

Angie

X X X X X X X X X X X X
X X X X X X X X X X X X

Counted by 2's for a total of 24.

Lee

X X X X
X X X X
X X X X
X X X X
X X X X
X X X X

Clay

X X X X
X X X X
X X X X
X X X
X X X
X X X

Didn't understand; rearranged them.

X X X X X
X X X X X
X X X X X
X X X X X
X X X X

Said 5,10,15,20,24.
Said 4x6=24

Grade 6

Brian

X X X X X X
X X X X X X
X X X X X X
X X X X X X

Said 4x6=24.

Kurt

X X X X X X X X X X X X
X X X X X X X X X X X X

Counted each one for a total of 24.

Michelle

X X X X
X X X X
X X X X
X X X X
X X X X
X X X X

Said 6x4=24.

Jennie

X X X X
X X X X
X X X X
X X X X
X X X X
X X X X

Counted each row and multiplied by 6 for a total of 24.

Glen

X X X X
X X X X
X X X X
X X X X
X X X X
X X X X

Said 6x4=24.

Ideas were taken from THE SECOND SELF by Sherry Turkle, Simon & Schuster, New York, NY 10020 and from Dr. Thomas C. O'Brien, Teachers' Center Project, SIUE.

HOW IMPORTANT ARE QUESTIONS?

Debbie Curry

> "Judge a man not by his answers but by his questions."
> Voltaire

How different our focus toward education would be if we followed Voltaire's advice came upon this quote while reading an issue of Science magazine and it caused me to start doing some thinking about our current concept of teaching. According to Dr. O'Brien, our American teaching methods focus on student handing back the correct answer. We give students praise for memorization and for being able to repeat back to us what we have taught them. How often do we praise original thoughts and creativity in the classroom? Are we preparing students for life, or are we programming them like computers?

As a secondary education teacher, I hear very few inquiry-type questions from the students. Of course, I hear questions like: "When is this due?", "How should this be done?", "When is the test?", etc. Rarely do the questions concern the actual material that is being presented. I hear few questions like: "I don't understand?", "Can you do this another way?", "What happens if...?", etc. Have the students stopped thinking for themselves and learned to accept what the teacher says as the ultimate truth?

In situations when a student does ask a question, the other students tend to make fun of him or her, and become impatient because they feel their time is being wasted. How did the students acquire this attitude? What happened to those inquisitive youngsters who used to ask questions about everything?

We teachers may need to look at our response to questions asked by students. Some things that should be considered are:

1) When a student asks a question, does your tone of voice and manner change to irrritation or give the impression that you don't want to be bothered?

2) Does your manner or tone of voice imply that the student is "stupid" for asking such a question? Do you talk down to the student or make the student appear to be a "dummy" to the rest of the class?

3) Are you afraid of questions from your students? Can you admit that you don't know all the answers?

4) Are you inflexible in your classroom presentation? Do you make plans and feel that those plans must be covered no matter what is happening in the classroom?

5) Do you encourage questions in your classroom? Do you have pauses in your lesson presentation to allow students time to consider the material and formulate questions?

6) Do you give praise to the students who ask questions?

7) Most important of all, do you allow opportunities for creative thinking and discovery learning? Are the students given an opportunity to discover their own answers, or do you spoon feed all the information to them?

I hope these questions may be of some use in self-examination. As teachers, let's strive to prepare creative and thinking individuals and not robots programmed with all the "correct" answers.

TRYOUTS
Jo Pattison

I used a class of eighth graders for my project. I "borrowed" them from a friend because I am not currently teaching.

The first activity deals with place value and probability. The materials needed are paper, pencil, one die, chalk, and a chalkboard. The children were instructed to make a drawing like this: ☐☐☐☐ I told the children I would roll the die four times, and after each roll I would call out the number . They were to write the number in one of their boxes, the objective being to make the largest possible number using the available digits. After each roll of the die, I called out the numbers and wrote them on the board in a vertical row. Upon completion of all four die rolls, I had the children call out the numbers they had chosen.

An example of one round would be:

A five is rolled, called, and written on the board, the same procedure is followed with the next three numbers, four, six, and two. The numbers called out are in a vertical row like this:

5
4
6
2

The children then call out their numbers and I write them in a vertical row leaving room, if necessary, for possibilities not selected by the children. The possibilities selected by the children were: five thousand four hundred sixty two (5462) and six thousand four hundred fifty two (6452). I then wrote them on the board and asked the children what other possibilities existed. We came up with the following list with appropriate point values assigned.

6542 - 24
6524 - 23
6452 - 22
6425 - 21
6254 - 20
6245 - 19
5642 - 18
5624 - 17
5462 - 16
5426 - 15
5264 - 14
5246 - 13
4652 - 12
4625 - 11
4562 - 10
4526 - 9
4265 - 8
4256 - 7
2654 - 6
2645 - 5

2564 - 4
2546 - 3
2465 - 2
2456 - 1

The children then figured their points. We went through three rounds discussing each time why they had selected a certain place value for each number. The choice was easy if a five (5) or a six (6) was the first number rolled. However, if the first number rolled was a four (4) or less, the choice was considerably more difficult. One boy consistently put the (5) in the thousands place if it was called first. He was reinforced enough to continue doing so. Others kept the thousand place open in the hope of getting a six. They were not reinforced as often, but apparently were reinforced often enough because they never deviated from their belief that the six would show up.

The second activity was intended to lead the children to look for patterns and develop tactics of problem solving. The children were divided up in pairs. They were instructed to write a seven on a piece of paper and then each in turn could add a one, a two, a three, or a four to each product. The one to reach 40 first was the winner. The objective was for the children to figure out a winning strategy. After the first run they decided that if you started the activity you won, because coincidentally that's what happened. So, I had them switch with the loser of the first game starting the second game. This time the children were totally confused because on this round the starter only won half the time. I had them play the game a number of times. After three rounds, a couple of children decided that if you reached thirty first, you won. We tested that hypothesis by having children challenge me at the chalkboard. They decided that getting to thirty only guaranteed a win if you also got to thirty five. I asked them if they thought it was possible to be assured of winning earlier in the game. On the board we played a number of games so that all the children were seeing the same numbers. Finally, one boy's face lit up. He had a winning strategy. Do you?

My thanks to Ms. Carol Ann Rundell, Principal of St. Boniface School, Edwardsville, Mrs. Chris Means, eighth grade teacher, and the boys and girls in the eighth grade class as St. Boniface.

It is going from error to error that we discover the truth.
Leo Tolstoy

A CONCERN

Alfred G. King

An interesting problem was posed this summer in the Thirteenth Annual Summer Course of The Teachers' Center Project. Sylvia divided our class into groups of about five participants each. We were then given cards with various mathematical problems written or drawn on them. Each card had a different problem. The problems were of different levels of difficulty.

We were asked to work as individual groups to put the cards in order of difficulty for American school kids. I am sure that most participants felt as I did, that this would be an easy assignment. After all, who would know better than a teacher what to expect from students?

Well, there was much disagreement in our groups. The groups finally came to an order, and Sylvia proceeded with the exercise. She asked "How many people are dissatisfied with the entire order that your group decided on." The hands were many? We were then asked to circulate to observe the order in which other groups had placed their cards. Every group's order was different. After we had returned to our original groups, Sylvia shared some of the motives that we as teachers used in determining the difficulty, Two rationales were something like his:

1. I don't teach this in the third grade, so I'm sure that they wouldn't learn that until later.
2. I didn't have that until the eighth grade.

Do you get the idea?

There was more to the exercise, but I will stop now to explain what I thought to be a significant finding.

The teachers in our Lingard Workshop taught at different levels. We had a kindergarten teacher, a high school coach and almost every grade between. The results of this exercise clearly suggest that there are tremendous communication gaps between grade levels. A high school teacher often does not have the slightest idea what is being taught in a middle or elementary school. Even teachers of the same levels, elementary, middle, and high school, do not know what or when subjects are being taught outside their grade.

This is cause for thought. How can I expect my eigth graders to perform for me when I don't know what they have been taught in earlier grades?

I suggest that these communication gaps be closed. What do you think?

A MATHEMATICAL METAMORPHASIS

Vicki Reulecke

As a teacher of Learning Disabled students, I was strongly of the opinion that my students needed instruction in only the "basics" of math. By basics I mean the operations of addition, subtraction, multiplication, and division. I justified this by the theory that they had difficulties with mathematical concepts and thinking, so why clutter their minds with unnecessary activities geared toward vague concepts they'd never use.

With this philosophy strongly in mind, I proceeded to use a math series, in workbook form, that almost exclusively taught the operations--at least I thought it taught them. After all, isn't the teaching of math merely repeated completion of page after page of the same type of problem? Doesn't practice make perfect? Or does practice merely make the lack of true understanding permanent?

If I sound critical of my own philosophy of math education, it's because I am. This change in my thinking is a recent occurrence and I can pinpoint the exact cause. I had my first exposure to the philosophy of the Teachers' Center Project just prior to the beginning of this school year. This has completely changed my idea of what should be included in a math curriculum.

My experience within the Teachers' Center framework was led by two very talented mathematics educators from Sheffield, England. They guided us through activity after activity, geared toward increasing the understanding of various math concepts which, once understood, make learning all mathematics much easier. The purpose of doing these activities ourselves was to give us not only a beginning repertoire of thought-inducing items for our students, but also to give us first hand knowledge of methods for presentation of these activities, and possible applications and extensions for use at various difficulty levels.

Now it seems to me that I've been putting the cart before the proverbial horse. If students aren't taught to think logically and mathematically, how can they learn anything in math? Answer- it is difficult if not impossible. In just one short month, I have discovered my students know nothing about number value, relationships, or the value of generating and eliminating alternatives. If these basic concepts are not mastered, there are undoubtedly many others as well. Without these basic thinking skills, they cannot perform any tasks that require manipulation of numbers, shapes, or thoughts.

Now that I have arrived at all of these personal revelations, what do I do about it? The first thing I did was to get rid of last year's math workbooks. I happened across the math text that is currently used in regular elementary classrooms in my district. After a quick perusal, I was pleased to find some activities in this series which were geared toward my new goal- teaching my students to think. The series includes frequent thought-provoking problems that require some basic knowledge of problem-solving techniques and cultivate the skill of elimination of alternatives. Both of these are very important skills that I find more strongly lacking in many of my students than in students in regular classrooms.

The other attractive thing about this particular text is the use of manipulatives. This makes any concept easier for a student to understand. Geoboards, dominoes, dice, markers, sticks, etc. have been absent from my classroom in the past, but no more.

The text does, of course, have its share of drill and practice. This, too, will be a part of my curriculum this year and probably for quite a few years to come. It must be this way because I am told we are seeking "Evolution not Revolution" in our classrooms. One can accomplish more through gradual change within a system than by complete defiance of that system. I will also continue the drill and repetition for another reason. I am not yet sure enough of my talents in choosing meaningful activities, nor have I delved deeply enough into the enormous amounts of materials that are becoming available to really know what is best for use in my classroom. If I do one or two thought provoking activities this year, at logical places in my curriculum, and then add several each subsequent year, eventually I will reach my goals. I will make my students better thinkers and problem solvers in all areas of their daily lives and I will make myself a better teacher.

NOTE: Our district math text is the Scott Foresman Mathematics Series, copyright 1980.

POLYA

What is good teaching? Giving opportunity to the student to discover things by himself.

Herbert Spencer

PREPARING A LESSON OR AN ACTIVITY

Author Unknown

Many times teachers feel uncomfortable and a little nervous about presenting a new lesson or activity in Math. This past summer I was introduced to a checklist to follow to help prepare for a new lesson or activity. It has helped me immensely this year, especially since we started a new Math series. This may also be helpful to you.

NEW LESSON OR ACTIVITY CHECKLIST:

(1) Have you done the Math lesson or activity yourself? You should do the lesson or activity yourself before presenting it to your students. This will help you feel more confident and also may help you better understand some questions or ideas your students may have.

(2) Do you have the equipment needed for the lesson or activity? You should have all the paper, manipulatives, materials, etc. needed for the lesson. Also, be sure you have enough material needed for all the participants.

(3) Have you considered the arrangement of the furniture in your classroom? You should know before class time how you want your desks etc. arranged to fit the needs of your lesson.

(4) Have you considered student grouping? You should know how you want to group your students--socially--abililty--etc.

(5) Are you prepared for the "Why are?" questions from your students? When one of your students ask, "Why are we doing this?" Respond in a truthful and pleasant way--Don't try to be defensive--that turns students off.

(6) Are you prepared for the "Why are you doing this?" from the administators? Be sure and have an answer to this question ready. Ex: You may reply by saying, "I want my 3rd graders to practice education. This promotes their thinking."

(7) Have you decided how to introduce your lesson? The opening or beginning of a new lesson or activity is very important. It must be appealing and presented in a way that is accessible to all quickly.

(8) Have you considered the time needed for the activity? You should be sure to allow enough time for your planned activity. The worst thing that can happen is to have to end an activity, just as students are really thinking creatively and bursting with ideas, due to lack of time.

(9) Have you decided on your evaluaton methods? You should decide ahead of time what evaluation methods you will be using.

(10) What are you going to do about your end product? After you have completed your lesson or activity you should share your results. You should display your end product and happenings, or write an article about it. Ex: a SEEDBED.

All teachers should remember: Good education is not just Kids learning from Teachers--- it is TEACHERS LEARNING FROM THEIR KIDS AND ADAPTING THEIR TEACHING TO HELP KIDS GROW.

BEAUTY

David Wells

(The following article, reprinted in its entirety with permission from David Wells, comes from David's lovely journal, The Problem Solver.)

'A mathematician, like a painter or a poet, is a maker of patterns...(His) patterns, like the painter's or poet's, must be *beautiful* ...Beauty is the first test: There is no permanent place in the world for ugly mathematics.' (G.H.Hardy)

'I think it is correct to say that (the mathatician's) criteria of selection, and also those of success, are mainly aesthetical.' (John von Neuman)

'The most beautiful thing we can experience is the mysterious. It is the source of all true art and science.' (Albert Einstein)

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These quotations, from the purest of pure practitioners, a mathematician who contributed to pure and applied mathematics and to physics, and the greatest physicist of this century, could be multipled many times over. Beauty is at the centre of mathematics-as-an-activity.

Therefore, if children are to *do* mathematics, to *be* young mathematicians, we must pay the closest attention to the aesthetic value of the problems we offer them.

We must offer problems which have aesthetic value *to them,* and, in addition, we must give them opportunities to develop their aesthetic sense and to make their own aesthetic judgements, which implies that we must offer them genuine choices.

*****

In what features does the beauty of mathematics reside? Or rather - what features appeal to which practitioners, because individuals do not all share the same likes and dislikes?

To my surprise, I do not know of any discussion of this point, so I shall attempt a rough analysis myself. Let me start with three features which are widely and easily appreciated, (labelled for ease of reference.)

A: *Simplicity* is attractive in the presentation of a problem, whether that is a match puzzle or Fermat's theorem that $x + y = z$ has no integral solutions for n greater than 2.

Simplicity is equally attractive in a solution. That is not to say that the solution must be easy to discover, only that it appears simple once insight has been achieved. (Martin Gardner's book, *Aha. Insight.*)

B: *Completeness* is attractive in a solution: a feeling that you have wrapped everything up, leaving no loose ends and no doubts about the correctness of your solution.

Completeness in the problem itself also attracts at least some mathematicians, for example, those seeking decision procedures for wrapping up entire classes of problems.

C: *Patterns* and symmetry appeal to everyone, though the professional may be appreciating the isomorphism between two highly abstract structures, while the young pupil is enjoying immediately percieved visual symmetry or the repetition in a number pattern.

*****

These three features are easy to appreciate. Here, however, the story becomes more complex, because the opposites of these features can also be aesthetically satisfying.

D: Complexity which appears unpatternable but turns out to have structure after all, may be highly attractive, while complexity in a solution may offer just the mystery to which Einstein refers; surely behind this long, meandering unmotivated solution there must be a simpler, more powerful approach?

E: Lack of completeness can also be attractive. Some problems allow easy partial solution but defy further attack. Or an attempted solution only reveals the original problem as embedded in a bigger problem, so that the original problem almost disappears in a much wider investigation. Mysterious?.

F: Similarly, a lack of pattern can be attractive. A while back, Scientific American magazine featured on its front cover one of the non-periodic tilings of the plane discovered by Penrose, using just two very simple shapes. Beautiful.

Polynomial equations up to the fourth degree can be solved using roots by not dissimilar methods. Why does this pattern then break down?

*****

I have emphasized the element of mystery in cases D/E/F rather than cases A/B/C. Why? Isn't there mystery in the simple patterns of even the most elementary maths? Yes, certainly there is, but it is impossible for small children to appreciate, or most older children for that matter, because the simple patterns they see are so strong. The pupil who enjoys the beauty of a honeycomb is scarcely likely to find the statement '2+2=4' as mysterious as did Frege or Peano.

The sense of mystery starts to exert its force when our expectations, based on cases A/B/C break down. This development is not limited to mathematics. Here is an example from physics:

> 'Until recently, traditional scientific thinking held that ultimately everything in the universe has a symmetrical equal and opposite counterpart,... but a beautiful theory has led to the finding that universal symmetry...is sometimes slightly violated, and scientists believe they have come upon a truth even more beautiful than the simple perfection of symmetry.'

Observe that the expectation of symmetry comes first, and the 'even more beautiful truth' depends on this expectation not being met. The expectation must have already been built up in the past.

*****

This analysis has been very rough. It totally fails to distinguish between steps in a problem, a neat idea, or a small but beautiful insight, and the attractions of a whole problem. I suspect this does not matter, as a step may display the simplicity, completeness in the sense of certainty and conviction, and the elegance of relationships of a complete solution.

I think, therefore, that I have said enough to draw my main conclusion that children should start to be mathematicans by attacking problems with features A/B/C, (though the teacher will be aware that problems are seldom if ever as simple, complete and unexceptional as they seem,) and only as they discover in their own practice unexpected snags, unanswered questions, inviting variations and surprising misfits, work towards problems in which D/E/F are major and initial features.

Let me illustrate this conclusion by considering two well-known but strikingly contrasted problems.

> 'Fit the numbers 1 to 9 into this square so that the numbers in each row, each column and each of the diagonals add up to the same total.' (Figure omitted)

Comments: Scores very highly on A/B/C. Easy-to-understand presentation, but difficult to solve. Any solution is self-checking, and shows strong pattern; middle number 5 must be in the centre of the square, odd and even numbers form a pattern , equal differences along diagonals and so on. The complete set of 8 solutions is related by simple symmetries.

It can also be extended to other magic formations, including larger squares, which score for simplicity of presentation but also start to score for D/E/F for solutions. For example the 3x3 square is nearer in solution to the 5x5 than the 4x4, (but the latter are very hard.)

Conclusion: a superb problem for developing pupils' entirely proper expectation that mathematics is elegant and beautiful and that this elegance and beauty is a very powerful heuristic aid in solving problems.

> 'Choose a number a make a chain using these rules: (A) if the number is even, divide it by 2; (B) if the number is odd, multiply it by 3 and add 1; (C) repeat with your answer. Investigate the chains you get by starting with different numbers.'

Comments: High on A, low on B/C. At best a modest pattern appears if all (?) the chains are joined together in the best possible way. Features D/E are making quite a strong appearance, and potentially F also. Professional mathematicians have not solved the obvious main problems in this situation, to the best of my knowledge. However, some variations in the rules produce problems which, at least potentially, are more complete.

Conclusion: Although frequently used with quite young secondary pupils, it is quite unsuitable. The satisfaction it can offer them is limited, while they will not appreciate the charm of a problem which is trivially easy to state but extremely difficult to resovle.

The satisfactions, very real, which they will derive from making certain small steps and hitting on some real insights, are all available in problems which offer, in addition, far greater global satisfactions.

This problem will do nothing to develop pupils' aesthetic appreciation of mathematics.

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May I end by urging strongly that all the problems, indeed all the work of any kind, that is offered to our pupils should be judged, among other criteria, by its (potential) aesthetic content and by its (potential) effectiveness in developing pupils' sense of mathematical beauty.

One final arrow: what percentage of material in even the best books should be thrown out, by this criterion? Dare I suggest 50% plus?

*****

The G.H.Hardy quotation starting 'Problems and beauty/ is from S.J.Heims, 'John von Neumann and Norbert Wiener' MIT Press 1980. Presumably it is from Hardy's book, 'A Mathematician's Apology'.

The von Neuman quote is also from Heims. I have no source for the Einstein quote. The passage on page 8 is from an article by Malcolm Brown in the New York Times, quoted in SEEDBED 5, the excellent journal of the Teachers' Centre Project. Southern Illinois University, Edwardsville IL 62026, USA

POLYA

The object of mathematical rigor is to sanction and legitimate the conquests of intuition, and there never was any other object for it.

J. Hadamard

POLYA

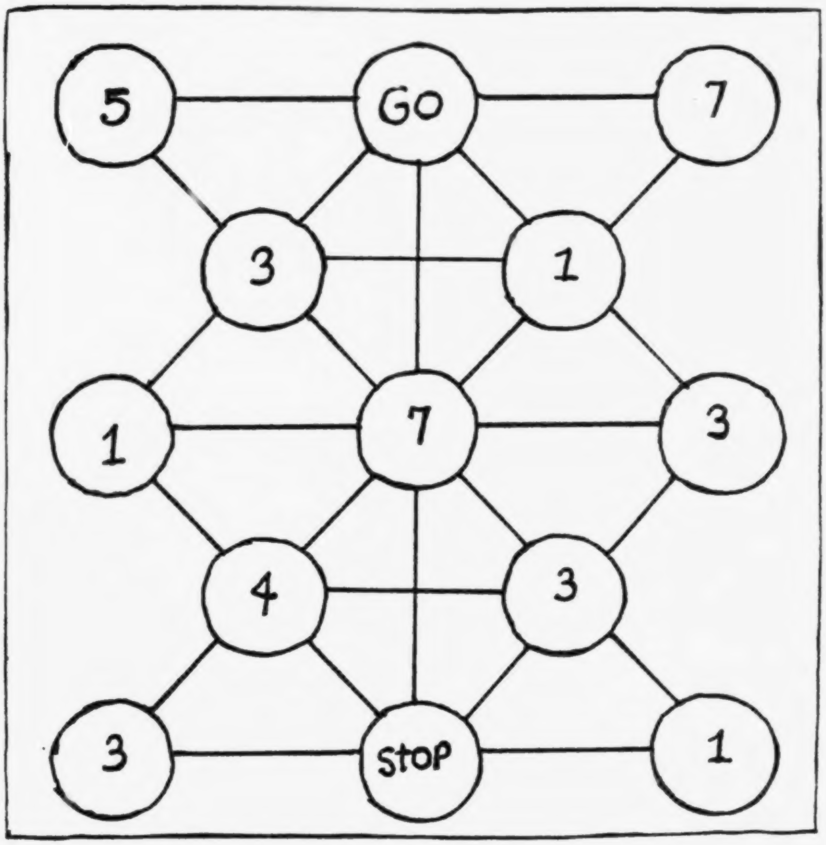
Nothing is more important than to see the sources of invention which are, in my opinion, more interesting than the inventions themselves.

Leibniz

GO GO GO III

Virginia Small

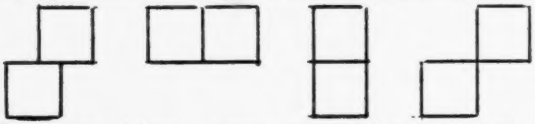
This problem solving puzzle was the most challenging to my first graders. This puzzle wasn't as easy to work as the other two and they discovered that they couldn't pass through all circles to get a total score. This puzzle was left on the board and each day we tried to discover new totals and different paths for totals already discovered. See how many different paths and totals your children can find?



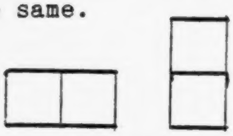
SQUARES, SQUARES & MORE SQUARES

Barb Hill

We often assume that each student has the same images or perceptions. If you asked your class to join two squares together, you would probably get several different answers.



At the same time, some students may not realilze that, for example, these are the same.



Here is a fun and challenging activity that involves this type of thinking.

You will need lots of graph paper to shade in squares. Present this question to the class: How many different ways can you connect two squares together so that the sides are touching at the corners?" The only way to connect two squares is like this:

Continue the activity by finding how many different ways you can connect 3, 4, 5, and 6 squares side by side. Set up a chart to look for relationships.

NUMBER OF SQUARES	NUMBER OF DIFFERENT WAYS
1	0
2	1
3	2
4	5
5	12
6	?

You will find that students will draw mirror images quite often. This gives them the opportunity to mentally "twist" the design around to see that it is the same shape as another. A mirror may come in handy.

After the class has found the different possibilities, have them copy the 12 different ways to connect five squares on a 7" x 10" square paper. Since te 12 different ways will take up 60 squares, they will have 10 extra squares to work around.

Once the students have all the shapes, cut them out and arrange them in a rectangle. They may have to turn some of the shapes upside down, etc. in order to make them fit.

My junior high class spent at least three days just trying to solve the rectangle. We found a 5 x 12, a 6 x 10 and a 3 x 20.

TWELVE DAYS OF CHRISTMAS

Ann Speichinger

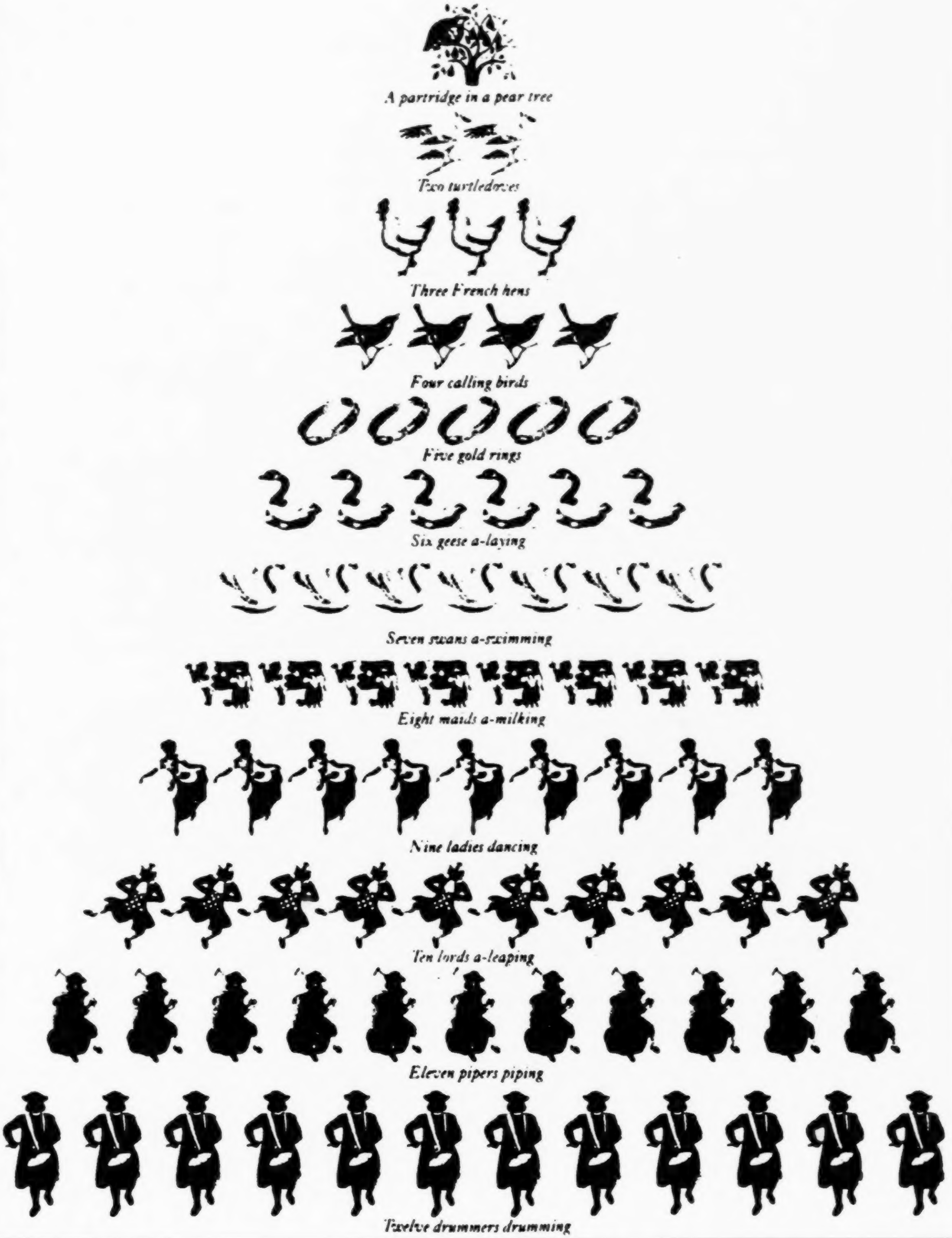
(This activity was suggested by Mary Steffen, who brought the issue to my attention and whose article on the problem appeared in the British journal "Mathematics Teaching.")

How many presents did my true love give me over the twelve days of Christmas? I passed out the problem to fifth graders in the class in which I was doing my student teaching. I asked the students to raise their hand when they had it figured out. As each student raised his or her hand I would go to the desk, look at the answer (which no one had correct), and ask how they got that answer (in every case they counted). Then I would ask them to sing the song starting at the second verse - "two turtle doves <u>and</u> a partridge ...." When they said "and", I emphasized it. The most recurrent response after a pause of a few seconds was "You mean I have to count all of those?" to which I responded, "Do whatever you have to to get the answer." After this same conversation took place about 15 times I addressed the class (30 students) as a whole with the "hint." The first time aound everyone came up with a answer of 78. After the hint I started seeing answers like 372, 354, etc. In most cases children had counted again, so their mistake was merely miscounting. I got a lot of groans when they had to recount. At this point though a lot of students were coming up the answer, most of them by counting like this:

```
1      4      10
       23     89        pointing to pictures
              567
```

I asked the class how many students had the answer and about two-thirds of the class had solved the problem. I asked the remaining students if they would like to continue working on it and they said yes. About 25 minutes had elapsed by this time. The teacher looked at me a little funny so I went up to her desk and asked if it was okay for them to continue. Her response was, "As long as you think they're getting something from continuing to work on this." In a couple of minutes some of the students who had solved the problem asked if they could help the others. I told them that if the other students wanted help they could. My cooperating teacher didn't seem to care for this too much thuogh and asked me to wrap it up and put a solution on the board. It was important to her that the answer be put on the board. I stressed to the studnts that there was more than one way to get the answer but that I would put one of the ways on the board. First I asked how they got the answer. Brad said he counted, so I asked how many had counted. Most of the class had. Then I asked for another way to get the answer. Carre R. said she put down 1 then added 3 then added 6 and ao on. Carrie V. said she combined counting and adding. First she counted all the pictures and put down 78. Then she started wi=th the eleventh row and counted the pictures up to the first row again. That gets 66, right she

How many presents did my true love give to me over the 12 days of Christmas?


A partridge in a pear tree
Two turtledoves
Three French hens
Four calling birds
Five gold rings
Six geese a-laying
Seven swans a-swimming
Eight maids a-milking
Nine ladies dancing
Ten lords a-leaping
Eleven pipers piping
Twelve drummers drumming

counted from the tenth row up, and so on, at which time she added all her countings. A long way to get the answer, but unique. She seeed to be on the verge of discovering a quicker way. Next I asked if anyone had done it differently. No one had so I put it on the board this way:

1
1 & 2
1 & 2 & 3
1 & 2 & 3 & 4
1 & 2 & # & 4 & 5
1 & 2 & 3 & 4 & 5 & 6
1 & 2 & 3 & 4 & 5 & 6 & 7
1 & 2 & 3 & 4 & 5 & 6 & 7 & 8
1 & 2 & 3 & 4 & 5 & 6 & 7 & 8 & 9
1 & 2 & 3 & 4 & 5 & 6 & 7 & 8 & 9 & 10
1 & 2 & 3 & 4 & 5 & 6 & 7 & 8 & 9 & 10 & 11
1 & 2 & 3 & 4 & 5 & 6 & 7 & 8 & 9 & 10 & 11 & 12

None of the students had approached the problem in this manner, but before I had even written the whole thing on the board Kevin saw that you could add all the ones, twos, threes, etc. and then add those totals for the answer. Charlie then said that you could just multiply the number of ones, twos, threes, etc., then add the totals. Then Billy saw that you could add the rows across and then add the totals. Again I stressed that there were many ways to get the answer and that counting was just as valid as multiplying or adding. At this point the teacher asked the students to get out their math books and their dittoes. What she didn't say out loud but what I heard in her voice was "Now let's get back to real math."

POLYA

The ideas should be born in the students' mind and the teacher should act only as midwife.

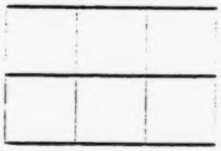
Socrates

THE GALLEY METHOD

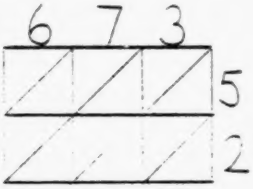
Lisa A. Winans

Recently I learned how to use the galley method of multiplication to find a product. After experimenting I found that this was of interest as well as help to students who have trouble multiplying double and triple digit numerals.

You begin by constructing a grid for the problem. For example the problems is 673 x 52. You set up a grid that has 3 squares across the top and two down the side.



The next stop is to divide the squares into diagonal halves and insert the numbers.



Begin at the far right by multiplying 3 x 5 and inserting its sum of 15 into the top right hand square.

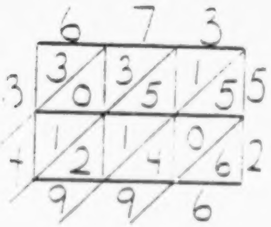
1/5

Continue with the remaining numbers and squares until each is completed.

To conclude simply add the sum of the numbers starting from the lower right diagonal.

Conclude by reading the answer from the left to the right.

34,996



Babe Ruth struck out 1,330 times.

POLYA

The chains by which the logicians imagine to be able to control the human mind seem to me of little value.

Decartes

(When introduced at the wrong time or place, good logic may be the worst enemy of good teaching.)

GRAPHING CAN BE FUN

Linda Carroll

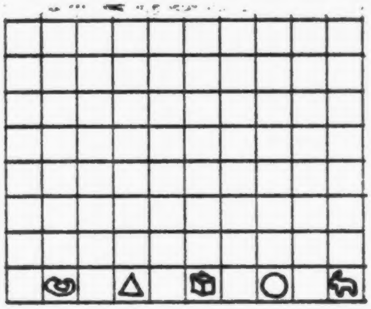
The graph is a very important communicating tool in mathematics. It can tell a great deal about the real world in a quick and orderly fashion. Kindergartners can learn to make graphs in a painless, even enjoyable way. Here is how I introduce this concept to my four and five year olds.

Before class, I prepare small plastic butter dishes (with lids) with several different objects: some contain a cube, some a counter, some a shape, some a link, and some a small toy animal.

Each child selects a dish and is instructed to look inside to see what object is in his dish. All the children having cubes bring their dishes and stack them on top of each other with a cube placed in front of the stack to show what is inside. We repeat this procedure until all the dishes are stacked in columns according to what object is inside. Then I ask such questions as:

*What object has the most dishes?
*What object has the least or fewest?
*Are there more dishes with links or shapes?
*Are there more dishes with animals or cubes?
*Do any stacks have the same or equal number of dishes?

After discussing the "real" graph, I give each child a prepared paper with bar lines and a picture of each object at the bottom. With a crayon they color in the number of squares starting from the bottom that coincide with the number of dishes in that stack.



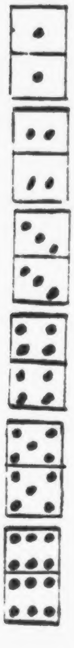
Later we graph favorite foods, favorite toys, favorite heroes, anything they like. When finished, they have worked through the process of transferring real objects to pictorial representation very gently and they love it.

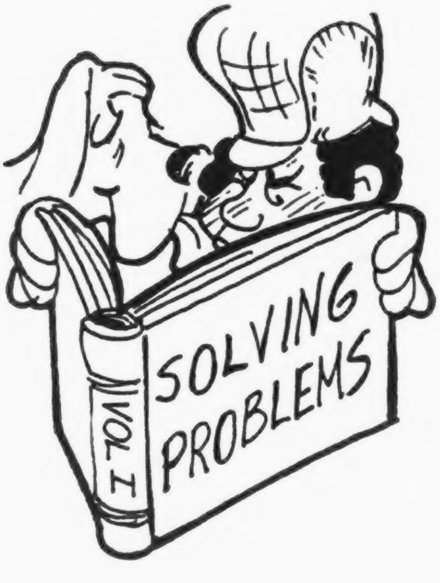
DOMINO MYSTERY

Mary Anne Jennings

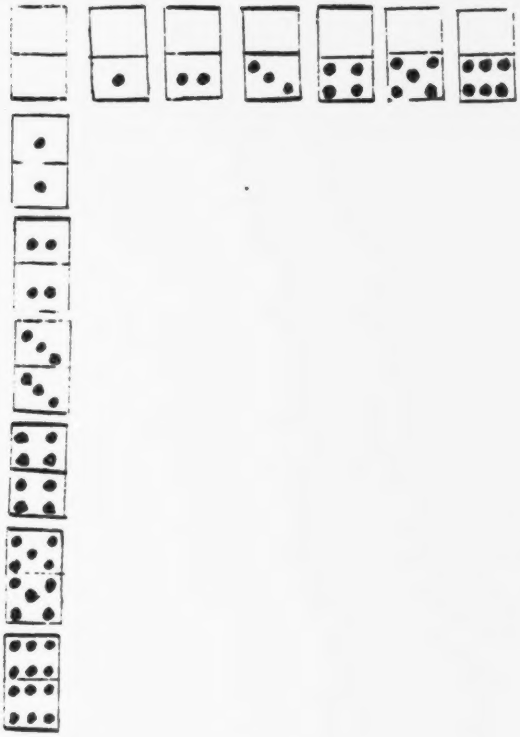
We purchased 2 double six sets of dominoes last year and through the course of playing various games, the two sets had been mixed together. I felt pretty sure that some of the dominoes were missing from the boxes. I emptied both boxes of dominoes and asked my eight year old daughter to help me figure out a way to know if we could complete at least one set with what we had before us.

She was very puzzled by my question and asked me what I meant by a double six set. She wanted to just count out 28 dominoes (since that was the number that she saw on the box) and have that be the set. We talked for a while about the differnt numbers that we might see on the dominoes. She began to reason out that a double six set had all of the numbers from 1 to 6 doubled. She picked out all the doubles (starting with the double one) and arranged them in this way:



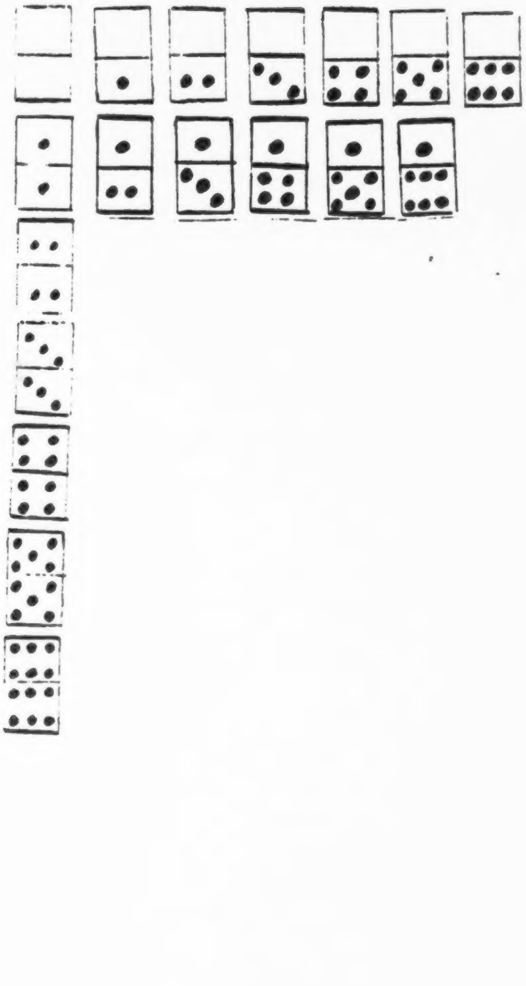


It was not until she had placed these six dominoes in front of her that she realized that she had another double--the double zero (or double blank). She placed it above the double one. Starting across from the double blank, she placeed all the dominoes that had a blank in succeeding numbers as shown here:

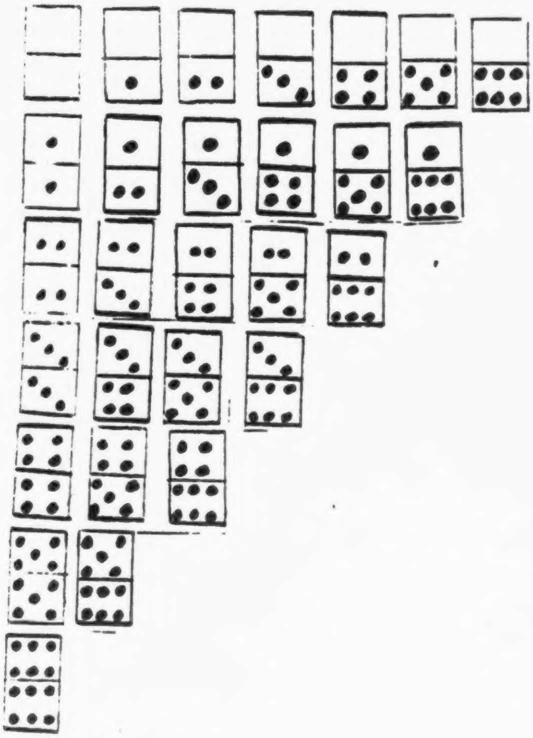


Heather continued on to the ones next, placing beside the double one, the progressing numbers 2-6 that had a one opposite them. By now, I thought she had the system all figured out, and was not paying close attention to what she was doing. After a while, I noticed she was not able to find the domino that she wanted. It surprised me when she told me she was looking for the domino with a two and a one on it to place before the double-two.

At this point, she had the following in front of her:



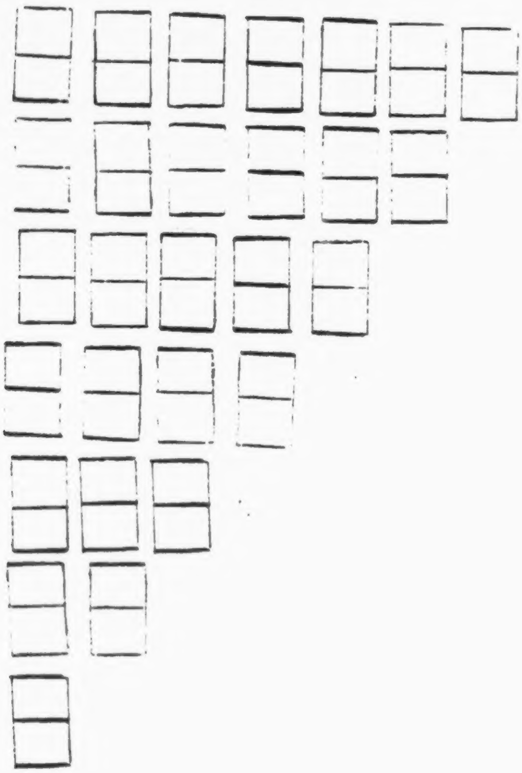
I explained to her that she had already used a one/two domino in the previous line. After that comment, she realized she just had to fill in the dominoes to the right of the double numbers in succeeding numbers. When she finished, this is what her solution looked like:



After Heather finished the solving of the problem, she was still dissatisfied. She told me she did not think she was finished. I asked her how many dominoes she should have in her solution. She remembered there were 28 dominoes in a double six set, so she counted the dominoes in her solution. She was still puzzled when she counted 28 dominoes. When I asked her what she expected to happen when she started the solution, she said she thought the rows would either stay the same in number, or that the rows would increase as the numbers increased. In other words, in her mind the double six should have had the most dominoes in its row.

She was unable to come up with any other solution at this point. She thought her solution was the only way this problem could be done. Although I knew that there was another way to do the same problem, I did not take time to think it completely through at this particular time.

After a few days, Heather decided to play around with the dominoes again. She called me to come up and see what she had done. She had the dominoes all turned upside down in the following fashion.



She pointed to the domino on top and asked me to guess which domino it was. I realized she could have found another solution or she could have simply turned her previous solution upside down. I told her she had given me a question whose answer I could not be positive about. This pleased her, to think she had tricked me. It also pleased me to see some creativeness in her that I had not seen before. I am hoping this is the beginning of her interest in problem-solving and in creating problems to be solved.

THE IMPACT OF COMPUTING TECHNOLOGY ON SCHOOL MATHEMATICS

REPORT OF AN NCTM CONFERENCE

One of the critical problems facing mathematics education today is the need for curricula and instructional methods to respond to the influence that computing technology is having on mathematics and its teaching. Numerous conferences, reports, and projects have focused on different aspects of the effect of emerging technology on mathematics curricula and instruction. For example, the Conference Board of the Mathematical Sciences produced a set of guidelines that identified fundamental topics in K–12 mathematics (CBMS 1983), and an NSF-sponsored conference at the University of Maryland resulted in a document that provided insight into the effect of the computer on subjects in the traditional secondary mathematics curriculum (Fey 1984).

NCTM has made many efforts to provide leadership as decisions about the impact of computing technology on mathematics education are made. In 1981 its Board of Directors established the Technology Advisory Committee, which has subsequently engaged in several projects and activities that serve members in the area of technology and which advises the Board on matters relating to technology and mathematics education. NCTM sponsors a continuing series of seminars for K–12 mathematics teachers on the uses of computers in mathematics instruction and has for a long time devoted program slots at regional and national meetings to issues associated with the impact of technology on mathematics education. The publications of NCTM, including the journals and the 1984 Yearbook, reflect the continuing concern of the organization with this issue.

In an effort to continue its leadership role, NCTM and the Center for Mathematics Education of the University of Maryland, with financial support provided by the National Science Foundation, sponsored a conference at NCTM headquarters during March 1984 to consider "The Impact of Computing on School Mathematics." Participants represented a number of interested constituencies: government funding agencies, commercial publishers of mathematics materials, the standardized testing industry, mathematics teacher educators, mathematicians, computer scientists, elementary, middle, and secondary mathematics teachers, and district-and state-level mathematics supervisors. Participants were asked to respond to a series of questions related to the impact of computing technology on the mathematics curriculum, mathematics instruction, and mathematics teacher education, and to formulate general recommendations in each of these areas. The conference produced the recommendations herein—each gaining broad, if not unanimous, support.

RECOMMENDATIONS ON CURRICULUM, INSTRUCTION, AND TEACHER EDUCATION

Prologue

Applications of calculators, computers, and other electronic information technology are reshaping the fundamental methods of doing and teaching mathematics. When used as tools for arithmetic and for the analysis of graphic or symbolic data, calculators and computers offer powerful new approaches to familiar problems and access to entirely new branches of mathematics. Applications of these same capabilities to instruction are bringing major changes to mathematics classrooms and the roles of mathematics teachers.

The major influence of technology on mathematics education is its potential to shift the focus of instruction from an emphasis on manipulative skills to an emphasis on developing concepts, relationships, structures, and problem-solving skills. Traditional precollege mathematics curricula have stressed the development of a variety of mechanical procedures, including the computational algorithms of arithmetic and the transformation of symbolic expressions in algebra, trigonometry, and analysis. The use of calculators and computers as standard tools in quantitative problem-solving situations, however, has diminished the value of human proficiency in the execution of such procedures. Much of the instructional time currently devoted to acquiring proficiency with paper-and-pencil algorithms should be reallocated to support a range of new or previously neglected topics that have a valid place in the K–12 mathematics curriculum. Moreover, teacher education programs must be modified to reflect these changes in school mathematics content and to model the delivery of instruction through appropriate applications of technology.

The proposals that follow are intended as guidelines for selecting the content of precollege mathematics curricula, for teaching that content in a manner that takes advantage of emerging technology, and for designing teacher education programs that recognize the changing curricular patterns and instructional roles for teachers. The proposals are based on five fundamental assumptions:

1. Coordinated change can take place simultaneously at all levels of mathematics instruction.
2. All students and teachers will have access to calculators and computers for the study of mathematics, in the classroom and at home.
3. All students will experience appropriate application of computers in the study of each school discipline.
4. State/provincial, district, and local mathematics curriculum guidelines and criteria for mathematics textbook adoption will be rewritten to reflect the changing priorities of school mathematics.

5. The publishers of standardized tests and instructional materials will
   (a) immediately begin developing products that are consistent with the changing objectives of precollege mathematics;
   (b) continue support for that development on a schedule that facilitates the implementation of proposed curricular changes.

TECHNOLOGY AND THE MATHEMATICS CURRICULUM

Today, the computational skills of arithmetic, algebra, geometry, trigonometry, and calculus dominate the K–12 mathematics curriculum. The content and sequences of courses are planned carefully so that students acquire intricate hierarchies of prerequisite skills for each major computational algorithm. Although these well-known mathematical procedures originated as essential aids to efficient problem solving, most of the algorithms of school mathematics have now been programmed for rapid execution by calculators and computers.

To do arithmetic today, mental operations are best for obtaining quick approximations; calculators are the tools of choice for one-time computations; and computers are most appropriate for repetitive calculations. In algebra, trigonometry, and calculus, computers can execute the numerical and symbolic manipulative procedures that students spend countless hours mastering.

As a consequence of this changing environment for mathematical work, the curriculum in grades K–12 needs careful reassessment and revision. Classroom teachers, mathematics supervisors, members of state departments/provincial ministries of education, authors and publishers of textbooks, developers of standardized tests, and other curriculum developers must consider the following recommendations and the questions they raise.

Elementary School Level

The elementary school mathematics curriculum has traditionally focused on developing students' skills in computing with whole numbers, fractions, decimals, and percents. Since computers and calculators can perform such operations more quickly and accurately than can usually be done otherwise, the traditional goals of elementary school mathematics must be reexamined and the predominance of computation-related objectives must be reassessed. Curriculum developers are urged to consider the following recommendations that suggest a broadened view of mathematics appropriate for grades K–4.

- Calculators should routinely be available to students in all activities associated with mathematics learning, including testing. Students should be taught to distinguish situations in which calculators are appropriate aids to computation from situations in which mental operations or paper-and-pencil computations are more appropriate.
- Emphasis should continue to be placed on students' knowledge of basic facts required for proficient mental arithmetic and estimation. However, significant portions of elementary curricula devoted to algorithms for multiple-digit calculations can be eliminated.
- Instruction must shift to emphasize the meaning of arithmetic operations. Such undestanding is essential for problem solving.
- Experience with physical manipulatives and other concrete representations of concepts must continue to be an important phase of learning mathematical ideas. Because of the increased instructional emphasis on meaning and understanding, this activity must not be overlooked as the curriculum evolves to take advantage of computers and calculators for instruction.
- Because computers and calculators can be used effectively in teaching mathematical concepts, no a priori assumptions should be made about the appropriateness of any given mathematical topic for elementary students. For instance, decimals, negative numbers, and scientific notation appear naturally when using calculators and can be taught as they arise. Computers facilitate an early introduction to geometric concepts such as transformations, congruence, and vectors; statistical concepts such as randomness; and algebraic concepts such as variable and function.
- Preprogramming activities and simple computer programming in Logo or BASIC can be done by students as early as the kindergarten level to convey both mathematical and computer concepts. Computer literacy should come as a natural by-product of such experiences rather than as a special addition to the elementary school curriculum.

Middle School Level

The mathematics curriculum for the middle school (grades 5–8) must take into account incoming students' knowledge of new topics such as computing, their understanding of topics formerly reserved for the middle grades, and their more limited skills in topics such as arithmetic algorithms. In addition to building on the changes proposed for the elementary grades, curriculum developers for the middle grades should consider the following specific recommendations.

- Mathematics in the middle grades should emphasize the development of "number sense"—the intuitive feeling for the relative sizes of numbers that is essential in skillful estimation, approximation, mental arithmetic, and the interpretation of results for reasonableness.
- Some portion of instructional time should be given to the study of discrete mathematics, including counting, graph theory, probability, and logic, which is important and appropriate for the middle grades.
- Calculators and computers can be used to teach iterative procedures for solving significant problems before traditional formal methods are presented. Such experiences should be part of the middle school mathematics curriculum.
- An introduction to statistics should include extensive gathering, organization, and presentation of data. Important concepts can be developed in the context of real data sets whose manipulation and examination is aided by computer analysis and graphing software.

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- Middle school mathematics programs should take advantage of the visual display capabilities of computer graphics that support and underscore the importance of informal geometry objectives. Transformations, mensuration formulas, and spatial visualization can be vividly illustrated by using computer graphics.
- Increased emphasis should be placed on such nontraditional methods of problem solving as organized lists, guess and check, geometrical sketches, and successive approximations, all of which are made feasible by calculators and computers.
- Computer programming experiences that introduce the concepts of variable and function should be provided. These experiences should help prepare students for the study of algebra.
- By the end of grade 6, students should be able to write simple computer programs that require looping and branching concepts. The emphasis in such programming activities should be on problems that convey significant mathematical ideas.

Senior High School Level

Developers of senior high school mathematics curricula must consider both the changing preparation of their entering students and the changing college and work environments their graduates will enter. The following recommendations are suggested as guidelines for the curricular evolution that must occur if high school mathematics programs are to reflect appropriately the influence of technology on mathematics and its teaching.

- The selection and sequencing of high school mathematics for college-bound students should no longer be governed solely by preparation for calculus. The most important mathematics for many students will consist of topics from discrete mathematics and statistics. High school programs must reflect these goals in their content and priorities.
- Computing is changing calculus and its traditional prerequisite subjects. Computer symbolic systems, graphics, and numerical analysis software make student mastery of manipulative procedures less important and, at the same time, offer dynamic tools for the illustration of fundamental concepts and processes. Such changes should be considered as the influence of calculus on high school mathematics is assessed.
- The content priorities and approaches to topics in high school geometry should be reconsidered in light of computer graphics and their applications. The geometry of three-dimensional space, trigonometry, vectors, coordinates, and transformations are all made more accessible with computer assistance through visual displays and complex calculations.
- The skill objectives of algebra must be reassessed to identify those procedures more easily done by computer (e.g., combination of expressions or solution of equations) or calculator (e.g., values of trigonometric functions, logarithms, or exponentials). The properties of elementary functions are still important for modeling quantitative relationships, but proficiency in many familiar computational processes is of little value.
- In many topics of high school mathematics, computers and calculators can be used to discover and test principles and methods. For example, concepts and theorems can be illustrated numerically and graphically to develop sound understanding before formal proof is attempted.
- For high school students with limited ability or interest in mathematics, technology offers an opportunity to enrich curricula with realistic problem-solving situations without insisting on a mastery of skill prerequisites. For example, these students can concentrate on the skills needed to collect, organize, and interpret mathematical information, skills appropriate for estimation and approximation, problem-solving strategies, data analysis methods, and reasoned evaluation of results.

The time needed for new curricula will probably exceed the time that can be saved by reduced emphasis on topics of diminished importance or by a more efficient organization of instruction. Mathematics is of such fundamental importance, however, that schools must allocate more time to its study. This means more minutes per day in the elementary and middle grades and more years of mathematics in secondary school.

TECHNOLOGY AND MATHEMATICS INSTRUCTION

The impressive capabilities of emerging technologies promise major changes in the organization of mathematics instruction and in the roles of students and teachers. Computers offer a dynamic electronic chalkboard for the demonstration of mathematical ideas. As laboratory tools, they assist in the exploration and discovery of concepts, the practice of skills, applied problem solving, and instruction by simulation. Computer-based evaluation and information management provide further opportunities for change in traditional teaching/learning patterns.

Although there may be risks associated with changing instructional patterns and teachers' and students' roles, the potential for improved instruction in mathematics makes the search for ways to reduce those risks worthwhile. If teachers and students are to exploit the potential of technology to support instruction, they must become adept at the new roles described in the recommendations below.

One of the most immediate consequences of the integration of technology into mathematics instruction is the increased need for teachers to make informed decisions about questions that relate to certain aspects of the mathematics curriculum. The following recommendations focus on these issues.

- Teachers must be able to make informed curricular decisions about the appropriate place and strategy for using technology to enhance instruction.
- Teachers must learn how dynamic visual displays made possible by computers can aid transition from concrete experience to abstract mathematical ideas.
- Teachers must become adept at interpreting and elaborating computer-based evaluation of student learning and in using information management systems that organize curriculum options and assessment data.

New roles for classroom teachers and students are also made possible by technological enhancements of mathematics instruction. Among these roles are the following:

- Teachers must become effective catalysts for student-directed learning. They must be able to pose stimulating problems and to probe student understanding with questions that begin "What would happen if . . .?"
- Teachers must serve as learning models in attacking mathematical questions. They must be comfortable assisting students in learning situations in which the topic being studied or the resource employed is unfamiliar. Teachers must be prepared to say, "I don't know yet," while they join students in exploration.
- Teachers must become facilitators of cooperative learning as students engage in realistic learning projects that computers make attractive. Teachers and students must emulate real problem solvers as they deal with problems of complexity, accuracy, and precision that occur in the collection and analysis of real data.
- For students, the greatest promise and challenge of technology in mathematics learning is the move toward more self-directed and self-monitored learning. Students must become adept at using computer-based instructional materials, mathematical tool software, and personal programming skills to develop and practice the use of mathematical concepts, principles, and problem-solving processes.
- Student-directed learning suggests that students may become dispersed throughout the learning environment. Teachers must know how to maintain effective communication with and among learners and must recognize that individualized technology-enhanced learning is not synonymous with independent study.

The fundamental theme that underlies recommended changes in patterns of mathematics instruction and in the roles of teachers and students is the emergence of a new relationship among teachers, students, and the subject matter. The presence of computers and calculators in demonstration, practice, problem solving, and evaluation creates a new classroom dynamic in which teachers and students are natural partners in the search for an understanding of mathematical ideas and a solution of mathematical problems.

TECHNOLOGY AND MATHEMATICS TEACHER EDUCATION

The recommendations in previous sections of this report suggest a new look to mathematics classrooms, with concepts and problem solving the focus of curricula and teachers joining their students as active partners in learning. If these changes are to occur, classroom teachers must be the primary agents of change. Consequently, preservice and in-service mathematics teacher education programs must be restructured to prepare teachers for their new roles.

Computer education for teachers of mathematics requires understanding and skill in three areas: (1) the uses of computers and calculators as problem-solving tools in mathematics; (2) the uses of computers for the presentation, evaluation, and management of instruction; and (3) the concepts of computer literacy that contribute to, or depend on, the knowledge of mathematics. The breadth and depth of appropriate computer education will vary with the teacher's grade level and subject specialization. The following recommendations provide guidelines to the content and form of preservice and in-service experiences suitable for elementary, middle, and senior high school mathematics teachers.

Mathematics content and methods courses in teacher education programs must be examined and restructured to give more attention to priority content areas and [illegible] make calculator and computer use an integral part of [illegible] such courses. In particular, the following recommendations apply:

- Students preparing to teach at the elementary level must complete the mathematics requirements outlined in the *Guidelines for the Preparation of Teachers of Mathematics* (NCTM 1981), with special emphasis on estimation, approximation, mental arithmetic, data organization and analysis, informal geometry (using a variety of approaches to the subject that reflect its visual nature such as transformations, vectors, and coordinates), probability concepts, and measurement concepts.
- Computer literacy and programming concepts needed by elementary teachers should be acquired through experience in the mathematics content and methods courses. Consequently, teachers preparing to teach at this level need not be required to take a formal computer science course, although a course focusing on computer applications in education is recommended.
- Students preparing to teach at the middle school level should also complete the mathematical requirements outlined in the NCTM *Guidelines* for this level, with special attention to the priority topics recommended for elementary teachers and experience with more advanced topics from algebra, analysis, statistics, and discrete mathematics.
- Middle school mathematics teachers should complete a course on computer applications in education and a computer science course that focuses on problem solving and, more specifically, on the nature of algorithmic thinking and the computer implementation of problem solutions.
- Students preparing to teach mathematics at the secondary level should complete the mathematics major outlined in the NCTM *Guidelines* and coursework in discrete mathematics, probability and statistics (including exploratory data analysis), and numerical analysis. All topics must be taught in ways that demonstrate appropriate applications of computing to mathematics.
- In addition to the computing courses recommended for middle school teachers, secondary mathematics teachers should complete study that provides further experience with structured programming, algorithmic thinking, mathematical modeling, and other mathematics fundamental to computer science.

To provide teachers of mathematics with the knowledge and skills needed to use computers and other technology effectively for instruction, programs of preservice and in-service education must include the following components:

- Level 1 (awareness). Through the use of computers, calculators, and other technology as an integral part of the delivery of instruction in mathematics, teachers must be exposed to a variety of applications that

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enhance their understanding of the potential of these technologies. They must experience a range of hands-on activities and explorations and see demonstrations of appropriate uses of technology in classrooms.

- Level 2 (Interaction with prepared software). Teachers at this level must be given training in the selection and use of appropriate software to enhance instruction in mathematics, and information should be given to them about sources of mathematics-related software. They must develop, deliver, and evaluate lessons and units that integrate existing software into mathematics instruction.
- Level 3 (Interaction with programming). Teachers should be given the opportunity to engage in programming-related activities such as tracing, debugging, or modifying existing programs, all of which can enhance mathematics learning. Such experiences should focus on how programming ideas can be used to teach mathematical concepts, not on developing the teacher's personal programming skills.

The most important point in these recommendations for change in mathematics teacher education is the requirement that preservice and in-service programs must model the desired changes. Teachers must *experience* mathematics content and methods courses that emphasize priority topics and that present those topics using a variety of techniques that fully integrate computers, calculators, and other information-processing technologies. The realization of this goal will require commitment and cooperation among mathematics and teacher education faculties. Institutions must commit needed resources for equipment and must support faculty study time.

- Every institution should identify a computer resource teacher who can serve as a technical advisor for all teachers and a mathematics/computer resource teacher who can provide leadership in helping teachers make appropriate use of computing devices in mathematics instruction. Institutional support for training such individuals will be needed.
- Institutions must provide ongoing support mechanisms. Administrators must be educated about proposed changes in mathematics content and the delivery of instruction and must be supportive of changes. Initiative and achievement must be recognized.
- Colleges and universities should work with local schools and districts to devise creative models for in-service programs to upgrade teachers' backgrounds and ways to provide support for teachers as changes are implemented. Such programs must build in mechanisms to inform teachers at upper levels about curricular and instructional changes at lower levels and vice versa.
- Professional organizations such as NCTM must offer training workshops to prepare teacher educators for leadership roles in effecting change. Funding agencies must offer support for retraining activities.

Well-educated, committed teachers will be the key
the successful implementation of curricular and instru
tional improvements. The computer education of prese
vice and in-service teachers represents a critical inve
ment necessary for change to occur.

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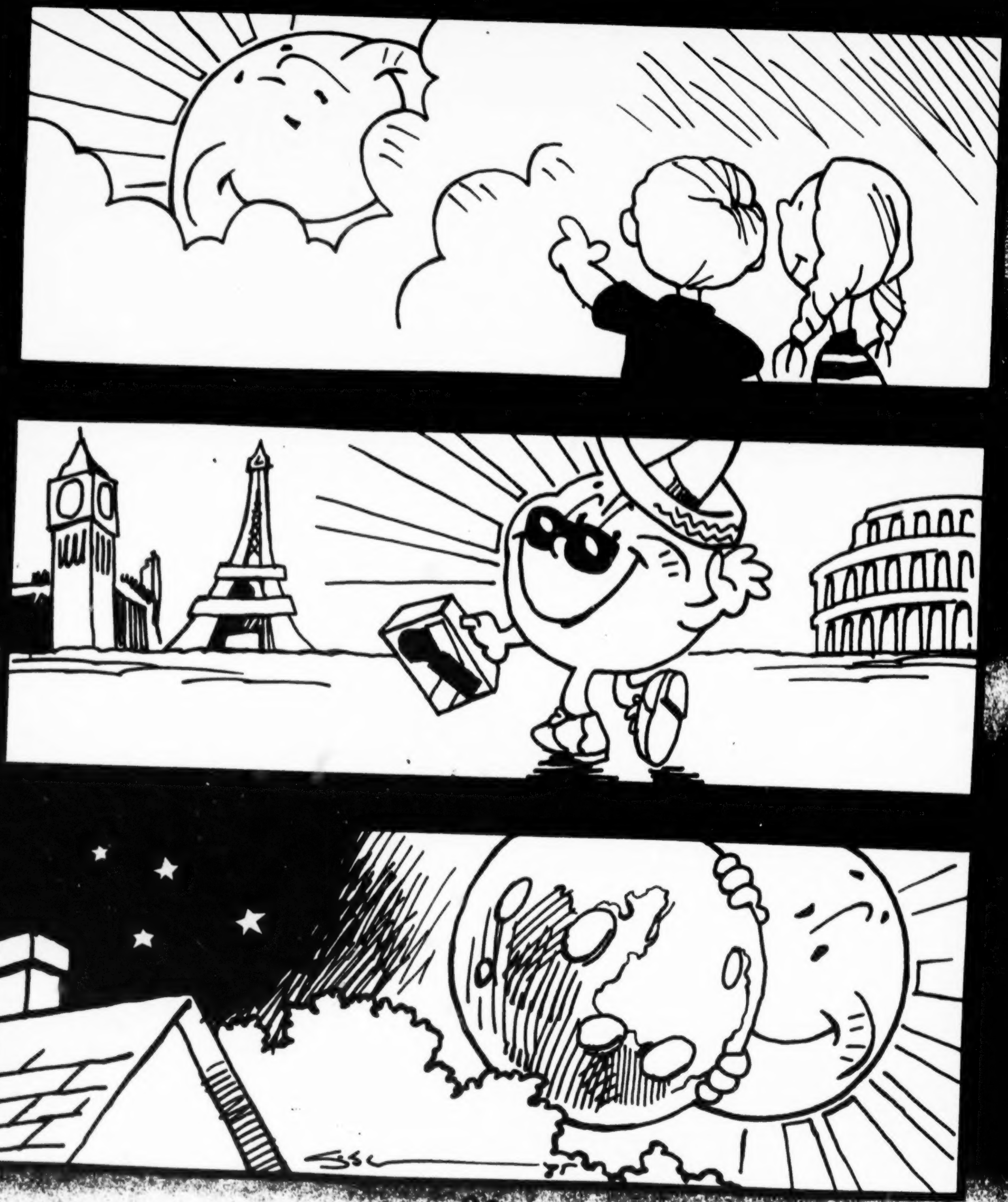


SEEDBED

NUMBER 23

JUNE 1985

Teachers' Center Project

SIUE

Southern Illinois University
at Edwardsville

INTRODUCTION

SEEDBED 23 grows out of the work of Teachers' Center participants during the 1984-5 school year at SIUE. Much of the material is singled spaced (for the first time in a SEEDBED) 'cos there were so many good ideas and too little space.

Enormous thanks and congratulations to the teachers and teachers-to-be whose ideas appear in the present SEEDBED. That teachers are immensely thoughtful and innovative on behalf of children's growth has become sort of a ho-hum idea hereabouts (after all, this is our 23rd SEEDBED) but it's an idea worth shouting about. The ball is in your court now. Read what's here, try things out, and share what you've run across. Knowledge is not a spectator sport.

Aside from the super work by teachers here, please take a look at the report of the National Council of Teachers of Mathematics. It's one of the most forward-looking documents in math education and it should be read and shared widely.

A note about "typesetting" in this SEEDBED. The printer didn't print exclamation points. Thus, reader, you are invited to punctuate with exclamation points wherever you think fit.

Warmest thanks to Barbara Goldenhersh for editing this issue and to Patricia Atkinson for being an all-purpose problem solver in the production of SEEDBED.

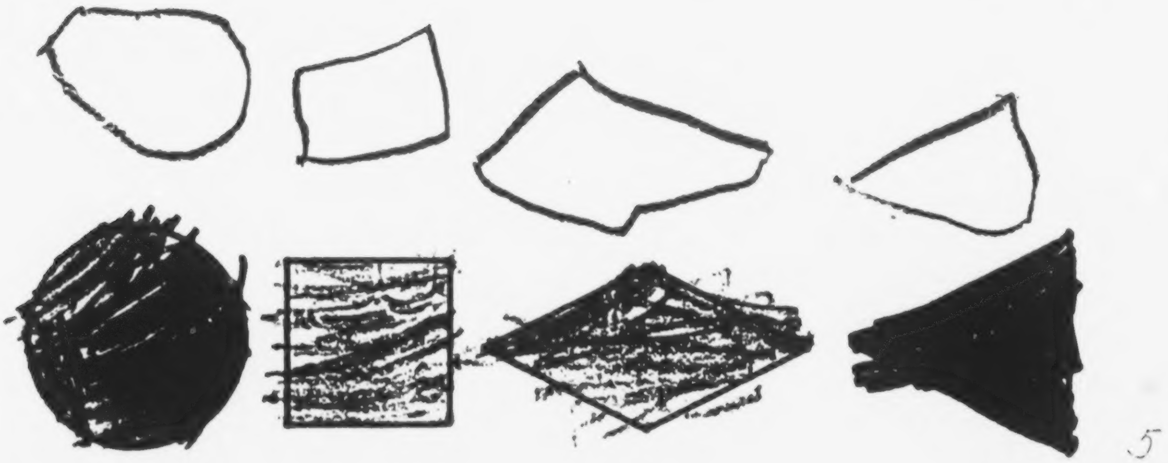
Thomas C. O'Brien
June 1985
Univeristy City, MO

ABOUT THE COVER

What's all this then? As should be widely known by now, Teachers' Center Participants are constantly interviewing children to learn about how they see the world. (Sixty years of Piagetian research -- in Geneva and throughout the world -- shows clearly that children see the world intrisically differently from the way we adults see things.) Some time ago, we asked children at various ages, "Where does the Sun go at night?" The issue is addressed on briefly in the present issue of SEEDBED, but the results should be enough to whet one's appetite for childwatching. Where does the Sun go at night? "Behind the clouds." "To another country." "Behind the Moon." The issue is one which Teachers' Center participants are addressing at the very moment, although the cover art, by Steve Gibbs, comes from children's responses several years ago. Tune in to one of the future issues of SEEDBED for further reports on Sun, Moon, and even Grandma's house. (One of the recent replies was, "It goes to Grandma's house.)

CHILDREN'S ART

What are all the diamonds and squares and squiggles and stuff scattered at the end of the SEEDBED articles? Barbara Goldenhersh was interested in the essential Piagetian question, "What do children make of the world?" She asked pre-schoolers (the ages are written on each piece of art) to copy four figures she had drawn. Throughout this SEEDBED are children's responses. We'll leave the interpretation of the work to you -- it's an issue which has been widely addressed in the Piagetian literature -- but one thing is clear. Unlike what is commonly believed in American education, the mind is NOT a camera.



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The Little Boy
Helen E. Buckley

(This poem was sent in by Sally Biarkis. Where it originally appeared was unknown to her; she first saw it on a ditto page circulating through her school)

Once a little boy went to school.
He was quite a little boy.
And it was quite a big school.
But when the little boy
Found that he could go to his room
By walking right in from the door outside,
He was happy.
And the school did not seem
Quite so big any more.

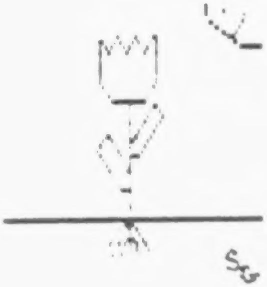
One morning,
When the little boy had been in school awhile,
The teacher said:
"Today we are going to make a picture."
"Good." thought the little boy.
He liked to make pictures.
He could make all kinds:
Lions and tigers,
Chickens and cows,
Trains and boats--
And he took out his box of crayons
And began to draw.

But the teacher said: "Wait.
It is not time to begin."
And she waited until everyone looked ready.

"Now," said the teacher,
"We are going to make flowers."
"Good." thought the little boy,
He liked to make flowers,
And he began to make beautiful ones
With his pink and orange and blue crayons.

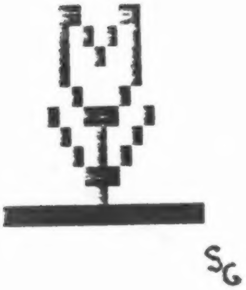
But the teacher said, "Wait.
And I will show you how."

And she drew a flower on the blackboard.
It was red, with a green stem.
"There," said the teacher,
"Now you may begin."



The little boy looked at the teacher's flower.

Then he looked at his own flower.
He *liked* his flower better than the teacher's.
But he did not say this.
He just turned his paper over
And made a flower like the teacher's.
It was red, with a green stem.



On another day,
When the little boy had opened
The door from the outside all by himself,
The teacher said:
"Today we are going to make something with clay."
"Good." thought the little boy,
He *liked* clay.

The teacher said:
Wait, it is not time to begin.
And she waited until everyone looked ready.

"Now," said the teacher,
"We are going to make a dish."
"Good." thought the little boy,
He liked to make dishes,
And he began to make some
that were all shapes and sizes.

But the teacher said, "Wait.
And I will show you how."
And she showed everyone how to make
One deep dish.
"There," said the teacher,
"Now you may begin."

The little boy looked at the teacher's dish.
Then he looked at his own.
He liked his dishes better than the teacher's.
But he did not say this.
He just rolled his clay into a big ball again.
And he made a dish like the teacher's.
It was a deep dish.

And pretty soon
The little boy learned to wait,
And to watch,
And to make things just like the teacher.
And pretty soon
He didn't make things of his own anymore.

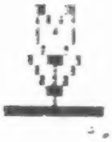
Then it happened
That the little boy and his family

Moved to another house,
In another city,
And the little boy
Had to go to another school

SG

This school was even bigger
Than his other one,
And there was no door from the outside
Into his room
He had to go up some big steps,
And walk down the long hall
To get to his room

And the very first day
He was there,
The teacher said:
"Today we are going to make a picture,"
"Good." thought the little boy,
And he waited for the teacher
To tell him what to do.
But the teacher didn't say anything.
She just walked around the room.



When she came to the little boy
She said, "Don't you want to make a picture?"
"Yes," said the little boy,
"What are we going to make?"
"I don't know until you make it," said the teacher
"How shall I make it?" asked the little boy
"Why, any way you like, said the teacher.
"And any color?" asked the little boy.
"Any color," said the teacher,
"If everyone made the same picture,
And used the same colors,
How would I know who made what,
And which was which?"
"I don't know," said the little boy.
And he began to make pink and orange and blue flowers.

He liked his new school
Even if it didn't have a door
Right in from the outside.

SG

LURKING 1

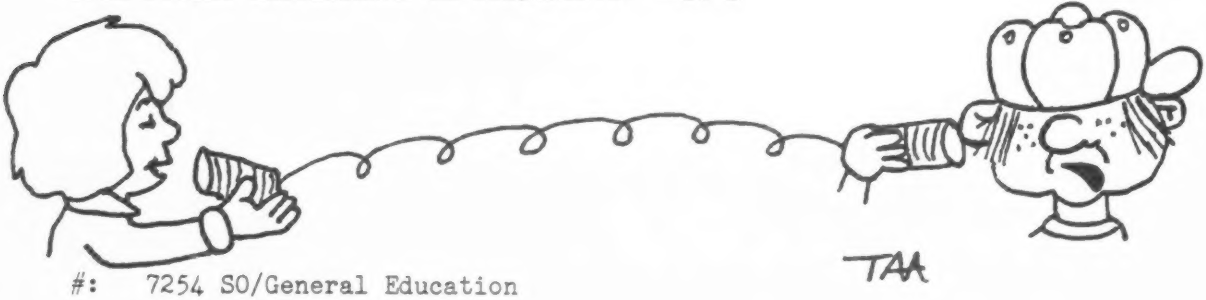
On computer bulletin boards and information exchanges, "lurking" means reading messages without replying.

Teaching is a very lonely profession. One talks, in the odd moments available, to one's next-door colleague and to the school secretary, but there is rarely the time and energy and opportunity for thoughtful, professional, long-term discussions of educational ideas, alternatives, philosophies.

And if there is time -- rare -- one's contact is limited by the boundaries that are all around us -- school boundaries, school system boundaries, town boundaries, state boundaries.

Information such as CompuServe and The Source enable rich exchanges of ideas in one's off-time (often late at night) among teachers all across the nation. The conversations, often between teachers who've never met and who may never meet in person, are among the most caring, informed, and thoughtful one might experience. I tune in nightly to five educational forums on CompuServe -- EDU-11, EDU-12, HOM-137, EDU-18 and an invitational forum -- and know of two others that I would dip into if time were available. Drop in, sez I.

Following, in what will be a continuing part of SEEDBED, are excerpts from recent discussions on CompuServe. --TO'B



#: 7254 SO/General Education
17-Apr-85 13:06:23
SB: NASA Satellite Link
FM: Ben Smith 70006,512
TO: All

Do any of you have access to the NASA Satellite Link which broadcasts live shuttle transmissions? Do you use it in your classroom operations?

Ben

#: 7255 SO/General Education
17-Apr-85 13:17:27
SB: #"Ask NASA"
FM: Ben Smith 70006,512
TO: All

I'm an educational specialist with NASA, and we are considering a relationship with Compusesrve through which we might be able to provide information to the educational user community. One format that is possible would be an "Ask NASA" feature, something like a "Dear Abby" approach, but dealing with NASA-related topics. I'd like to hear some feedback from you as to how you think this might be received. Would you have any other suggestions for how NASA could serve the educational community through a network like this?

Ben

#: 7256 SO/General Education
17-Apr-85 13:27:22
SB: NASA Teleconfereances
FM: Ben Smith 70006,512
TO: All

NASA currently has a program by which we have classroom lectures conducted remotely. Here's how we do it: we prepare a slide presentation in advance, and send a stack of slides to the school hosting the lecture. Then we have a NASA scientist connect to the classroom via a speakerphone audio link. The teacher shows the slides while the NASA lecturer speaks through the speakerphone. Have any of you made use of this service, and for those who have not, would you like to learn more about it?

BEN

#: 7261 So/General Education
17-Apr-85 20:58:35
SB: NASA Telecommunications
FM: John Mundt 70156,525
TO: Bill Smith 70006,512

I am intrigued by the NASA Telecommunications and the idea of an "Ask NASA" column for two reasons. First, I am a teacher in Chicago and this would be of great interest to my students. Second, I am starting a database for teachers in the area and many would be interested in what NASA has to offer. Can you get more information to me? You can send it to Teachers' Aide PO Box 1451 Oak Park, IL 60302 or leave it here on compuserve and I can get back to you.

#: 7265 So/General Education
18-Apr-85 01:40:23
SB: #7255-"Ask NASA"
FM: Tom O'Brien 76703,450

TO: Ben Smith 70006,512

Seems to me that the sky's the ... No, I won't say it. Seems to me that NASA could be an incredibly rich resource for kids and teachers at all levels. Your "Dear Abby" notion is quite approriate, sez I. Fair warning: watch out for the 10-14 year olds of the world. You may find yourself farming out their questions to Sagan, Einstein, Bohr. Are you prepared? Worth doing.

#: 7268 So/General Educaion
18-Apr-85 02:18:11
SB: #7255-"Ask NASA"
FM: Robert A. Fowkes 70775,1415
TO: Ben Smith 70006,512

Ben,

Contact Rick Needham, the science education sig sysop for on-line interactions. Several projects in that area have been started in prototype sessions and he is looking to expand to other science areas. Once again, the sig is located at HOM-160.

-RAF-

#: 7270 So/General Education
18-Apr-85 03:37:20
SB: #7255-"Ask NASA"
FM: Sister Ann Fraas 72376,2244
TO: Ben Smith 70006,512

Sounds Super... I have been a space nut for more years than I can count. Have always wanted to be the first nun on the moon myself and now my students would like to make that possible. Seriously I would love it... Sister Ann

#: 7280 So/General Education
18-Apr-85 11:15:06
SB: #7255-"Ask NASA"
FM: Anne Beversdorf 70014,1056
TO: Ben Smith 70006,512

Ben- I have been reading your messages for the last few days and am quite excited on your interest and good ideas. The "Ask NASA" idea is a winner, in my opinion. I am not a classroom teacher, but serve as a resource for teachers--who are frequently asking me for ideas for student use of compuserve.

Another possibility (already being used by the Science Ed Forum-Do pose your suggestions there, too-Edu-13) is for you and/or other NASA scientists to schedule occasional real-time interviews/conferences with students. The Science Ed Forum did one this semester with 5th grade students from a particular school in PA.

Welcome to the Forum, and I'm looking forward to seeing more of you in these-here parts. --AB

#: 7311 So/General Education
21-Apr-85 21:20:42
SB: #7255-"Ask NASA"
FM: Rebecca Olmstead 70615,1232
TO: Ben Smith 70006,512

I think the interest NASA is starting to show in science education is really needed. It would be most useful to me if you used the data library on compuserve to provide current information which could be downloaded and provided to teachers for reproduction for students or incorporation in lesson plans. Several other NASA projects have been of great interest to my school: 1) Gasnet which gives on line information about currently scheduled launch plans; and 2) the experiment package where NASA provides seeds which have been in space so that they can be compared with garden variety seeds.

#: 7325 So/General Education
23-Apr-85 17:48:18
SB: #7255-"Ask NASA"
FM: Jim McCauley 70014,1136
TO: Ben Smith 70006,512

How about the straight poop on the status of the Galileo mission, which is supposed to include both an orbiter around and a probe into Jupiter?

Is it still on track, or has our weapons-happy government knocked it awry?

THE THIRD WAVE: BOOK REVIEW

Beverly Arnoldi

A sentence on the first page of the introduction of The Third Wave caught and subsequently kept my interest. The sentence was "The Third Wave is for those who think the human story far from ending, has only just begun."

There are many violent and bizarre happenings in the world today. Alvin Toffler proposes that all of these seemingly unrelated events or trends are interconnected. He describes what are dangers facing us, at the same time pointing out new potentials that are being produced and discovered. The main argument of the book maintains that "there are powerful reasons for long range optimism, even if the transitional years immediately ahead are likely to be stormy and crisis-ridden."

For simplification, Toffler divides civilization into three parts - a First Wave agricultural phase, a Second Wave industrial phase, and a Third Wave phase now beginning. Presently there are many conflicts resulting from the collision of the second and third waves. There is a bitter struggle raging between those who seek to preserve industrialism and those who wish to supplant it to construct a new tomorrow.

Toffler describes each civilization as having it's own techno-sphere - an energy base linked to a productive system which in turn is linked to a distribution system; socio-sphere - interrelated social institutions; info-sphere - channels of communication; and the power-sphere.

The Second Wave was characterized by the market. The wide split between the consumer and producer resulted in standardization, specialization, synchronization, and centralization. Families tended to be nuclear, with the man working for a large corporation or public agency and his wife being a mother and housekeeper. Education was "produced" by the teacher and "consumed" by the student. There was a dramatic rise in the standard of living. The second wave also brought with it irreparable damage to the ecological environment. There are numerous other characteristics, good and bad about the industrial society. Each section in the book can be related to an individual's own experiences and knowledge of the world. Toffler cites two changes which make the "normal" continuation of industrial civilization no longer possible. The first of these two is "the war against nature". The biosphere will no longer tolerate industrial assualt. Second, nonrenewable energy can not be relied on indefinitely.

The third wave civilization must draw on a wide variety of energy sources - hydrogen, solar, geothermal, tidal, biomass, lightning discharges, as well as others not imagined, and ultimatedly, self-sustaining renewable energy sources. The third wave civilization will also rely on a more diversified technological base. These technologies will be designed to use less energy, and many will be small in scale, simple to operate, and with the wastes of industy predesigned for recycling into primary materials for another.

The most basic raw material of all (inexhaustible) would be information and imagination.

In education more learning will occur outside the classroom. Years of compulsory schooling may grow shorter. Education will become more interspersed and interwoven with work, and more spread out over a lifetime.

Computerization will be embedded everywhere in society. Factories will perform less brutalizing and repetitive work, noise levels will be low, and workers will be able to come and go at hours convenient to them. They also will be found outside urban metropolises and be much smaller.

The most striking change in the third wave civilization will probably be the shift of work from both office and factory back into the home. "The rise of the prosumer (fusion of consumer and producer), the spread of the electronic cottage, the invention of new organizational structures in business, the automation and de-massification of production, all point to the home's re-emergence as a central unit in the society of tomorrow."

The nuclear family will be only one of many socially accepted and approved forms of family life. A new "extended" family may develop as a result of the shift of work back to the home and networking in communications.

The third wave society will move to flexible rhythms, and schedules will be built on segmentation and diversity and will dispense and de-concentrate.

Political institutions may be based on three principles: Minority power; Semi-direct democracy; and Decision division. These are described as bettering the chances for a peaceful transition between the second and third waves.

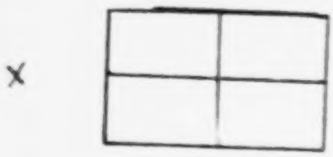
This book was not written as an absolute guide to the future. The Third Wave attempts to synthesize what is occuring in the present to what may develop in our future. It is refreshingly optimistic, while covering a wide array of information. This book gave me a fresh new outlook about the world and how it works. It also gives the reader a sense of direction. The responsibility of change lies with each individual to look toward the challenge of the future and meet it face to face.

DIAGONAL DIFFERENCES

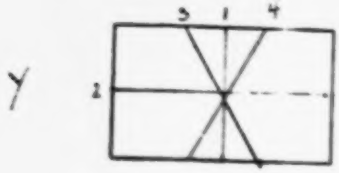
Karen Riess

As a child-watching activity, I asked a group of sixth and seventh grade students to fold a piece of plain 8 1/2" x 11" paper in half. I explained that by "half" I meant the pieces would be the same if they were cut apart on the fold line. I took each student into the corridor so that no other student could have observed and copied any of the folds.

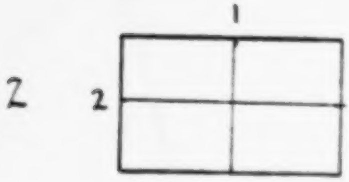
Sixth Grade Results



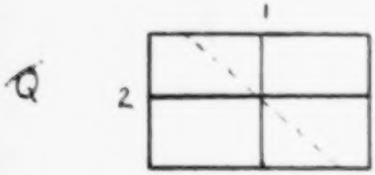
Student X folded the paper "forward" and "backward" on the lines indicated and said that was all she could do. Student X is one of the students who attends our gifted program and is considered by many teachers to be the best student in her class.



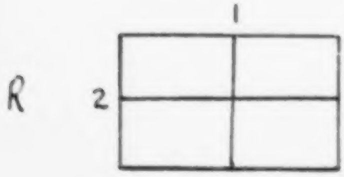
Student Y, also in the gifted program, folded along lines 1 and 2. For lines 3 and 4, she matched the corners. She was also positive there were no other ways.



Student Z easily found lines 1 and 2. He started to fold along a diagonal but stopped. When asked if these were the only ways he said yes. I then asked him about the diagonal. He folded as if to try to make a square and wanted to cut the rest off. He said that if he couldn't cut the rest off, then lines 1 and 2 were the only ones possible.

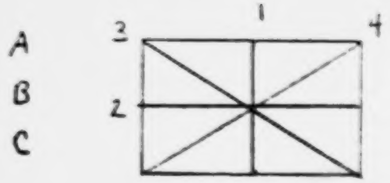


Student Q also quickly folded along lines 1 and 2, then "bent" the paper a few times without making any definite creases (shown by the dotted line). He waited a while and stared at the paper, and then declared there were no other ways.



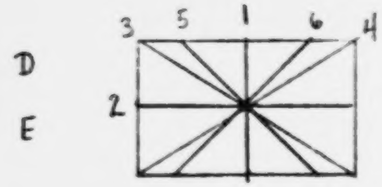
Student R folded along lines 1 and 2, and as he tried to fold corner to corner announced that he had seen it done before but he just couldn't do it right now. He was sure there were other ways, he just didn't know what they were.

Seventh Grade Results



Students A, B, and C folded quickly along lines 1, 2, 3, and 4 and said that was all the ways.

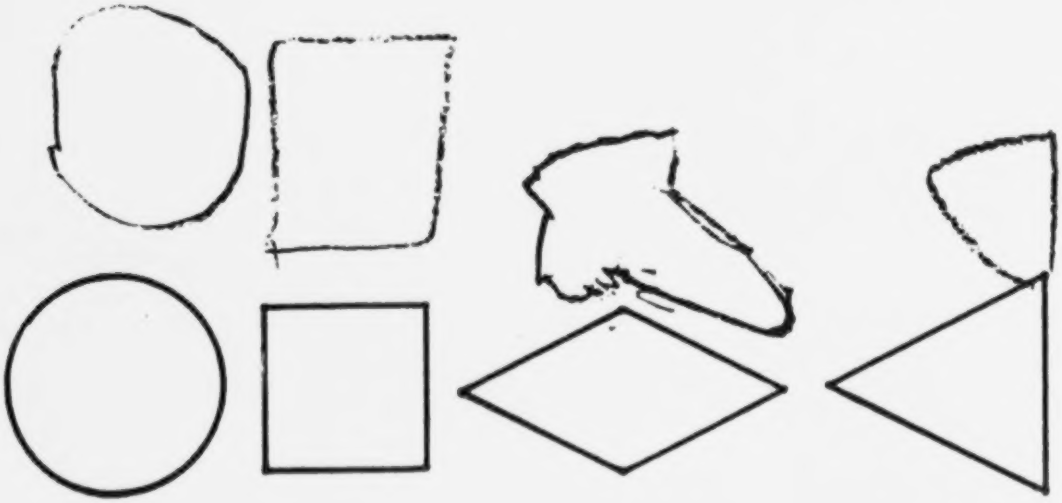
Student D methodically folded along lines 1, 2, 3, 4, 5, and 6 and then said there was an infinite number. Student D (as Students A, B, and C) is not in the gifted program, but is excellent at solving new material presented to her.



Student E, whom I consider to be one of the most truly gifted students I have ever had (and who does attend the gifted program) folded along lines 1 through 6 and said aloud as she did them, "Rectangles, triangles, trapezoids--Hey, look. There are an infinite amount of trapezoids."

I found two points to be quite interesting as I observed these students. The first was that none of the sixth graders were able to find the true diagonal, while all of the seventh graders found them easily. I found it absolutely amazing that one year could make such a difference in their perception of the problem.

The second point I found interesting was that so many of our "gifted" students could not find any more than the most obvious of lines. One of them had gone so far as to ask me, "Are you going to teach us this later, or what?" She seemed to be telling me that she didn't want to do it if I wasn't going to tell her exactly how to do it.



4

BEHAVIOR LABELING

submitted by Barbara Goldenhersh

If an adult is reinforced for behaving appropriately we call it RECOGNITION.
If a child is reinforced for behaving appropriately we call it BRIBERY.

If an adult laughs we call it SOCIALIZING.
If a child laughs we call it MISBEHAVING.

If an adult writes in a book we call it DOODLING.
If a child writes in a book we call it DESTROYING PROPERTY.

If an adult sticks to something we call it PERSERVERANCE.
If a child sticks to something we call it STUBBORNESS.

If an adult seeks help we call it CONSULTING.
If a child seeks help we call it WHINING or CHEATING.

If an adult is not paying attention we call it PREOCCUPATION.
If a child is not paying attention we call it DISTRACTABILITY.

If an adult forgets something we call it ABSENTMINDEDNESS.
If a child forgets something we call it RETARDATION.

If an adult tells their side of a story we call it CLARIFICATION.
If a child tells their side of a story we call it TALKING BACK.

If an adult raises their voice in anger we call it MAINTAINING CONTROL.
If a child raises their voice in anger we call it a TEMPER TANTRUM.

If an adult hits a child we call it DISCIPLINE.
If a child hits a child we call it FIGHTING.

If an adult behaves in an unusual way we call them UNIQUE.
If a child behaves in an unusual way we refer them for PSYCHOLOGICAL EVALUATION.

ARE WE THE SAME?

Liz Bollwerk

I just made an interesting discovery which can be applied to any aspect of education in which learning is the issue. The discovery took place after a session with a set of fraternal twins which were in my class of 4 year old preschoolers.

I was observing a group of children on an individual basis to record their counting abilities. The procedure was as follows:

1. Scatter 9 Lego bricks on a table and ask the child to count them.
2. Ask the child to close his eyes and remove two of the bricks leaving seven. The child would now open his eyes and count them again. These questions were asked:
   How many are there now?
   How many were there before?
   How many are missing? How do you know?
3. Show the missing bricks and replace them. Ask the child to recount them for confirmation.
4. Do the same as #2, this time remove three. Ask the same questions.

In general, the seven children observed were all able to count the nine bricks, but when asked how many were missing, confusion occurred. I am not sure if the children understood the question or if they had not obtained the concept of numerical value yet.

The twins were fraternal as I stated before. Knowing the twins and their family history gave me some expectations of them.

1. The twins would both do well since their mother is a teacher and I know for a fact that she spends a great amount of time with them. They are given enriching experiences.
2. The twins would be able to perform equally well since they have both been exposed to the same experiences.

I was wrong. The twins could both count well. This skill had obviously been mastered. I found Chris to be more cognitive; he could do the mental addition and subtraction that was involved in the counting task listed previously. Chad could not do this task. His facial expressions demonstrated that he did not have a clue as to what I was asking him to do. I found Chad to be more mechanical. Chad could tell me which row of bricks had more and why, whereas Chris could not.

This observation may not sound very powerful, but think about it for awhile. It took me about 4 days before I reached the following conclusion.

Children, no matter how closely bound, are not the same. Yet, we teach them as if they all had the same experiences and rate of development. Many teachers assume the pupils within their classroom have had the same exposure and are capable of the same abilities. If twins are not, how can we assume that children without any relation are?

RHYTHM IN COUNTING

Cynthia Kinney

One of the discoveries I've made this quarter is what seems to be the necessity for rhythm in counting. I think every student in our class noted in the discussions the oral rhythm that each person interviewed used. Many times the oral rhythm was accompanied by head nodding or fingers or feet tapping to the rhythm of the counting. Sometimes the oral rhythm was accompanied by more than one gesture.

Does that rhythm make the counting easier? Or does counting cause the rhythm? I interviewed a second grade girl who seemed to need to establish the rhythm before she could count. A sixth grade boy broke the rhythm in the early 40's when beginning with 38. Again, when he re-established the rhythm he went on smoothly to 70. Are we actually counting beats or movements?

Is rhythm used when actual objects are counted? Or might movement again be counted rather than the objects themselves? When a person, child or adult, counts coins, he moves the coins or touches them as he counts. Have you ever tried counting several objects that cannot be touched or moved. Have you had to count the objects several times to be sure of your answer?

The use of rhythm and movement seem to be an integral part of counting for all ages.

THERE'S MORE TO COUNTING THAN MEETS THE EYE

Beverly Bonkoski

A counting task would seem like a simple challenge to pose to children. That was my initial thought as Dr. O'Brien assigned such an activity during one of our Teachers' Center sessions. I was not optimistic about making many discoveries or gaining new information regarding children's thinking. As I explain my activity and observations, you will see that I was proved wrong (A pleasant surprise I might add.) and that a "counting task" can provide some valuable information about children. In the following paragraphs, I will first describe the details of my activity and then follow with the observations I found to be the most relevant.

While I learned a great deal in this sharing session with a second grader and some fifth graders, I must say at the outset that I enjoyed the activity and more importantly the kids enjoyed it also. The task involved asking the children to count by two's starting with the number 12, then the number 33, then the number 86 and finally the number 89. Once this series was completed, I asked the children to count by ten's starting first with the number 17, then the number 33 and lastly with the number 88.

I first asked a second grader named David to join me. He breezed through the counting by two's segment and he successfully counted beyond the number 100. During the counting by ten's segment I asked him to start with the number 88. Once he arrived at the 200 series he would say the numbers: "208, 218, and 228", but then stopped saying the "200" and just said: "38, 48, 58, etc., etc." He also did this into the 300's. His system would be to start a new hundred's series by saying the first three numbers and then drop the saying of the hundred's numbers and vocalize the ten's places. David economized his counting while always being aware of or keeping track of what hundred's series he was on. I have to add that while he was counting, he smiled at me but had no front teeth, yet he had the cutest toothless smile in town.

My next victim was a fifth grader named Joelle. She really did some interesting things. First of all, she easily went through counting by two's, each time going as far as 200. The crazy stuff started happening when she began counting by ten's. In the first series that started with the number 17, she skipped saying "107" saying the number "117". She then skipped by 100's saying the numbers "217, 317, and 417". When counting the numbers with a starting point of 33, she skipped saying the numbers, "113, 213, and 313". Beginning with 88, instead of increasing by ten, she began after the number "98" to increase by 100. She said: "198, 298, 398 and 498", and became confused and asked if she could stop. So we did. As I thought about this later, it actually was easier to keep the ten's place constant and increase the hundred's place. Joelle may have become confused but she actually made the task a bit more manageable for herself.

Angela was the second fifth grader I shared with. She did well with counting by ten's and counting by two's except for the series that started with the number 33. When she came to the number "75" she began counting consecutively and realized her mistake and got confused. I will comment on the "odd-numbered" problems in my observations.

Tony was the third fifth grader to join me. He tried to count by two's with the number "33" and struggled. He was so confused that he asked me if he could skip this number because he "got all messed up." Then when he started counting by ten's with the number "17", he had some trouble even starting. He "counted on" to the number "27" and then followed the pattern smoothly. When he tried counting by ten's starting with the number "88", he did well, except that he skipped the numbers: "118, 218, 318, and so on" just as Joelle did.

Tom was the last child I shared with. He had no problems while counting by ten's. Interestingly, he had some difficulty when counting by two's with the numbers: "86 and 89". He had trouble getting started but once he got to the number "90", he moved along smoothly because this is where the pattern is established. In other words, getting to "90" is just like staring at "0" and the pattern moved along more smoothly from there.

Once I completed my sharing session with the children, I had time to formulate some ideas about what I had encountered and found this activity to be very insightful. I would like to initially make two general observations and then elaborate on these observations with the hope that it will help to clarify some of the "funny things" that the children and I experienced.

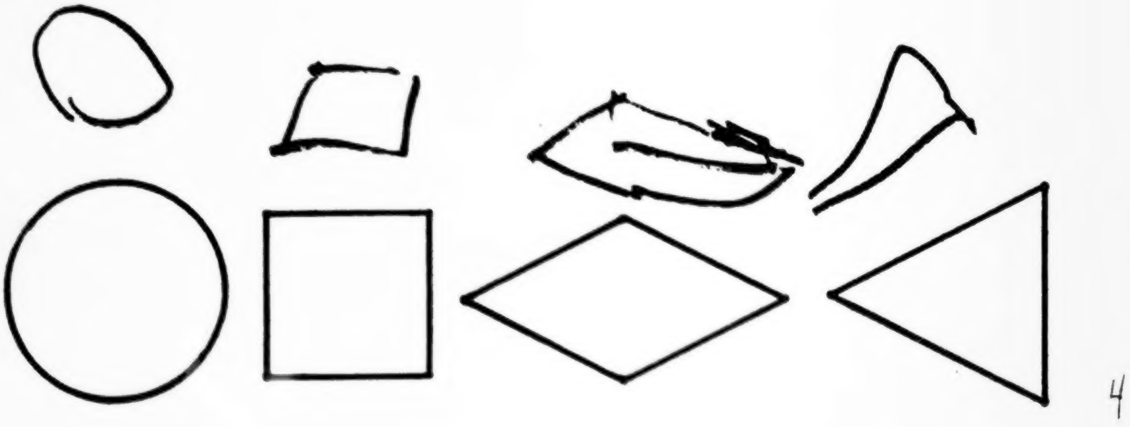
First, children, if given the opporunity, can become aware of the patterns that are an integral part of the learning and exploring of mathematics. It may be helpful here to share a very relevant statement made at one of our sessions with Dr. O'Brien. The statement is a quote from Professor Gyorgy Polya: "Mathematics is being lazy and letting the principles (patterns) do the work." My second observation is tied to the first. I was a bit disheartened by the fact that some fifth graders struggled with the the counting task. I really thought they would approach the activity with an attitude like: "This task is so easy, is this all we have to do?" Yet they did struggle and part of the reason may have to do with the little time available in exploring math. If children can begin to make stronger connections in their learnings of math, they may become more successful at mathematics' tasks and hence find them more meaningful.

To some degree the children were aware of the inherent patterns of numbers. In fact, I noticed that Joelle and Tony were actually skipping a break in the pattern. What I mean is, they skipped numbers like, "113, 213, and 118, 218, etc.", because the actual saying of these numbers broke the lovely pattern of saying: "123, 133, 143, and 128, 138, 148". The saying of the "3" or the "8" at the end of the numbers was much more rhythmical than saying "13" or "18" which would break the rhythm. They attended to the pattern and rhythm of the numbers and were not even aware they had skipped some numbers in the sequence. Tom felt more comfortable starting with the number "90" when counting by two's than using the number "86" as a starting point. He wanted to get to the beginning of the pattern ("0") in order to better manage the counting by two's task.

The children also had some problems with the odd numbers when counting by two's. This was like going "against the grain" for some of them. I would add that this may be so because children found these numbers to be a little "tricky", and yet these numbers follow a pattern much like the even numbered sequences. I believe that children should be able to make these connections with numbers. I also believe that some of the children labored under the misconception that math is full of roadblocks and obstacles. It's time we (teachers) start removing the roadblocks and let the children explore the paths that a journey into mathematics can take. Tony and Angela became frustrated and stumbled upon some roadblocks, while the other children started the odd numbered sequences very slowly but then managed to continue.

On the whole, the counting by ten's task was an easier one for the children to manage. Each time I posed a new sequence, whether it be to count by two's or by ten's, the children took a few moments to think about the problem. It was almost as if they were taking a "look at the map, before taking the trip".

A simple counting task, then, is not so simple a task after all. Perhaps those who read this will be tempted to try this activity with children they encounter. You may also be surprised at what observations and findings you can discover.



BOOK REVIEW: THE ENQUIRING CLASSROOM

Ed Rensing

How often do we as teachers complain that our students do not show interest in their studies, do not take pride in their work, or retain what has been taught? We continually drill our students with facts in the hope that learning will take place and yet, even after our students have memorized an abundance of information and can spew it back in rapid succession, they cannot apply what they have learned to everyday life situations. Why is this happening? If you seek an answer, I suggest you read The Enquiring Classroom by Stephen Rowland.

Throughout his book, Rowland emphasizes that a child needs control over his/her own learning. This means that the child must be aware of the purpose of the activity and that he/she will be the ultimate judge of its value. In order for this to occur, there must be a two-way process of teaching and learning between teacher and student. The student must not only "attempt to interpret and assimilate the knowledge and skills offered by the teacher," but the teacher must also "attempt to understand the child's growing understanding of the world." If the child really has an understanding of the situation, he/she will discover the enjoyment of learning and will make better use of the resources available in the classroom.

Rowland states that "when a child realizes that a skill is needed and when invention has prepared the ground for the mastery of it," he/she will learn that skill, and that skill will become internalized and will stick. Skills learned in sequence as determined by the teacher or a publisher are meaningless to that child. Not until the student realizes its relative importance will he/she practice that for mastery. All this, however, depends upon the control the child has over the activity.

To enable the child to control his/her own learning, a conversational relationship must develop between the child and teacher. This will permit the child to reflect upon his/her activity and give us, as teachers, opportunities to present new ideas and alternative perspectives about his/her work. Through mutual dialogue the child will be able to build upon his/her own experiences with the teacher as a resource person for new ideas and information while still maintaining control over the activity.

To establish control over the material environment for the classroom, the child should be offered materials covering a wide range of topics and be permitted to work with them in his/her own manner. In order to avoid aimless activity, the teacher should maintain a collaborative relationship with the student so that the process of research and discovery will continue.

At times these materials will not have any educational value in themselves other than acting as a catalyst for further research. The materials will lead from one activity to another and further development will occur. As the materials are handled, new ideas will emerge and former ideas will become more defined.

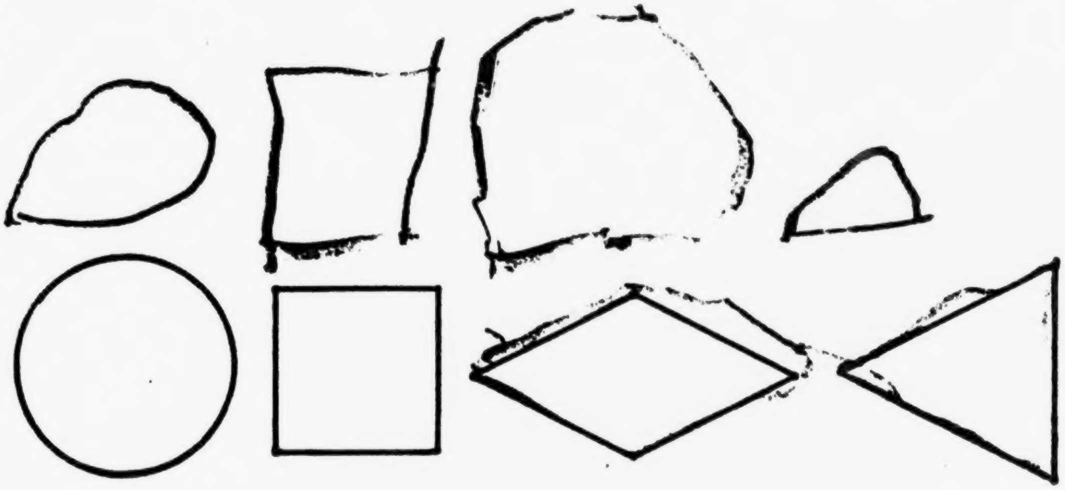
The materials should be "open-ended" so that the students will impose their own structure upon them. Otherwise the materials will limit the ability the student has for creativity and understanding. This is not to say that materials will not have their own limitations for they will. In this case, the student will reinterpret his ideas and develop a method with a clear goal in mind.

While working with these "open-ended" materials, the students will make mistakes which will lead to new interpretations of the activity. While this is occurring, the student will be testing his/her hypothesis and refining his/her ideas. All the irregularities will eventually be accounted for and the hypothesis will either be accepted or discarded. As new evidence emerges more research will ensue and better theories will be discovered and developed.

Once the child has gained control of his/her external environment, he/she will also "attempt to control the internal life of thought and imagination." The child will not only demonstrate an awareness of the activity being investigated, but also of the operations themselves. His/Her level of abstract thinking will increase as each hypothesis is being framed, tested, and refined. If a skill needs to be mastered to further the investigation, that child will readily attempt to master it.

These are just some of the thoughts Rowland has expressed in his book. At first the entire concept of relinquishing control to the student seems threatening. Upon further thought, however, and you may agree or disagree, isn't this what we seek as individuals also? We all wish to be in control of our own lives. Why not offer this opportunity to our students.

Information and quotes taken from The Enquiring Classroom by Stpehen Rowland, The Falmer Press, Taylor and Francis, Inc., 242 Cherry Street, Philadelphia, PA. 19106-1906



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THE PLEDGE OF ALLEGIANCE

Shelley Gilomen

Five days out of the week the children stand up to face the flag, put their right hand over their heart, and state the words they have known since kindergarden. But what does all of this mean to the children? I don't think the children understand what they are saying. The Pledge of Allegiance is just part of the school routine. The children have it memorized. Do the children ever think about what they have memorized?

I conducted a Piagetian experiment with five students to see how much the children actually know about the Pledge of Allegiance. First of all, I asked the students to write the Pledge of Allegiance. All of them did this correctly, with a few minor errors in spelling, capitalization, and punctuation. One girl wrote, "Please rise for the Pledge of Allegiance" before writing the Pledge of Allegiance. I then asked the students to tell me what the following words from the Pledge of Allegiance meant: allegiance, indivisible, republic, justice, and liberty.

My first student was a sixth grader named Lori. She didn't know what any of the five words meant. The next student was Trish, an eigth grader. She gave a vague answer for republic, stating it's all around us." I don't think she knew what it really meant. She stated that justice was "everything equal." She could not define the other three words. Jenny, a seventh grader, didn't know the definitions of allegiance and republic. She defined indivisible as "the opposite of divisible, hard to punch up against." Liberty meant "freedom." Justice was defined as "where you do no evil, commit no sins." The fourth student was Tommy, an eighth grader. He gave the following short definitions:

allegiance-loyalty
republic-our government
indivisible-can't be broken apart
liberty-freedom
justice-rights

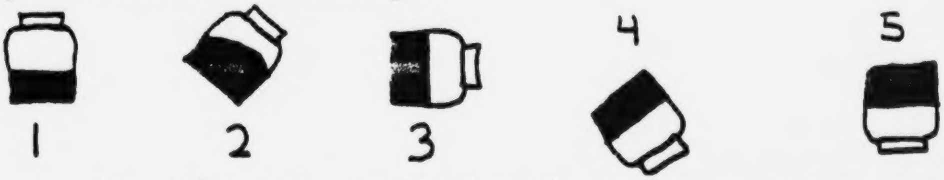
My last student was an interesting sixth grader named Eric. He didn't know the meaning of allegiance. He gave the meaning of invisible for the definition of indivisible. He defined republic as "what party Ronald Reagan is in, not the Democratic party." Justice was defined as "with a judge and court and they try to get rid of the evil." Liberty was defined as "trust, peace, the Statue of Liberty."

My five students didn't know what most of the words in the Pledge of Allegiance actually meant, so I don't think they know what the whole thing means. I don't ever remember wondering what the Pledge of Allegiance meant when I was in school. It was something I said five days out of a week. It was part of my routine, just as brushing my teeth twice a day. I don't remember ever being instructed on what it meant or why I said it. The Pledge of Allegiance has a special meaning. Maybe we ought to share this with the children who say it everyday in our classroom?

WATER THAT DEFIES GRAVITY

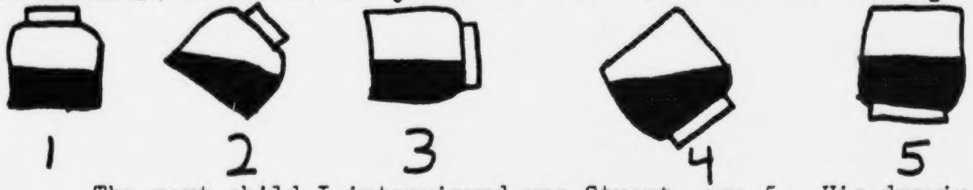
Ruth Stemler

My child watching task was to present children with a jar of water in various positions and a piece of paper with jars at various angles. Children were asked to draw the level of water on the paper as they saw it in the jar. The results were interesting. I interviewed five children at ages of 4, 5, 5, 6, and 13. The first child was Mindy, age 4. Here are her drawings:

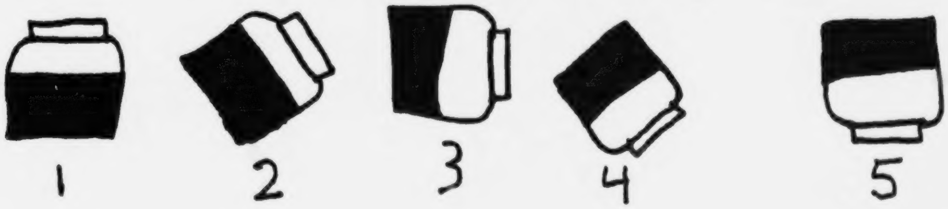


She did not see the level of the water move, except on jar #2. The line is curved, but in the wrong direction. Her pictures defy the laws of gravity. She did not even look at the jar while she drew. She did not understand that the level of the water would change, so why look at the jar. In fact, after she was finished, she asked me why there was water in the jar anyway.

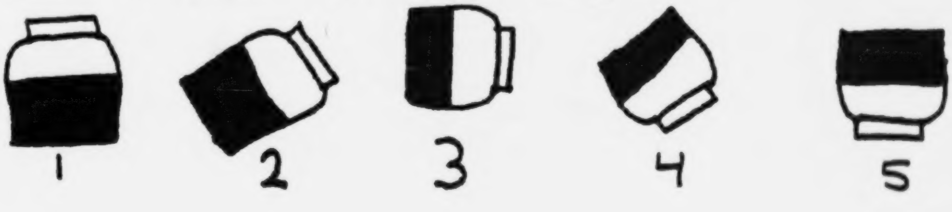
The second child I interviewed was Brian, age 6. His drawings very closely resembled reality. I assumed that this was natural for six year olds. Tom O'Brien assured that this was rare, however. Brian, unlike Mindy, looked at the jar as he drew. Here are his drawings:



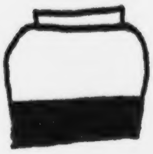
The next child I interviewed was Stuart, age 5. His drawings defied the laws of gravity as well. He, too, did not look at the jar as he drew. What he drew was impossible. Here are his drawings:



Shawna's drawings were the same as Stuart's. She did not look at the jar, either. When I suggested it, she was on position #4. On this position, she looked at the jar for several minutes before drawing. It made no difference. Here are her drawings:



The last child I interviewed was Sarah, age 13. She was very precise about where her lines were drawn. She, and only she, commented on the fact that the drawing did not match the jar. I think she noticed this because she felt the drawing had to be exact. The fact that the drawings did not match made this impossible. In drawing her lines, she would get down on eye level with the jar. She would look at the jar and at the drawing both as she drew. The other child who drew correctly also looked at the jar, but not as closely as Sarah. Here are her drawings:



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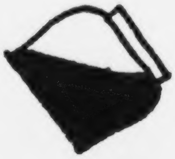

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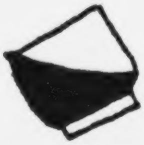

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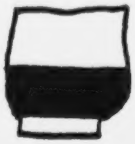

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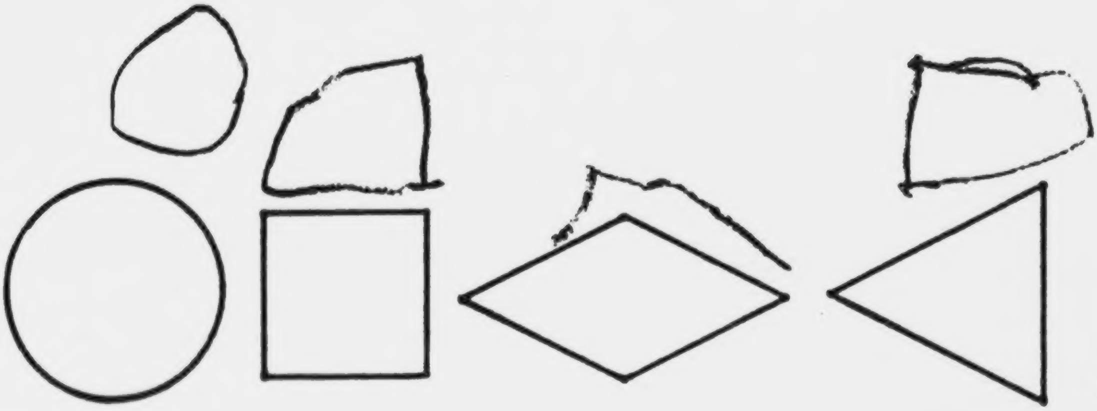
What developmental differences in this small research. The mind is not a camera.



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FACTORS OF SCHOOL READINESS

Barbara Goldenhersh

1. IT SHOULD BE BEHAVIOR AGE, NOT BIRTHDAY AGE OR I.Q. WHICH DETERMINES THIS. Many children experience difficulties in school because "maturity was a major factor that had not been taken into account. Many of the children were in trouble not because they were slow, not because they had not had adequate preschool experience, but because they needed time to grow .... Some children unready for the work of the grade to which custom and the law assign them are not so much immature as merely too young by birthday to do the work of their grade. Our own experience has been that the average girl does best if fully five before she begins kindergarten.... Boys on the average develop more slowly than do girls, and do best if fully five and one half before starting kindergarten."

2. "IT IS ESSENTIAL NOT TO CONFUSE A HIGH INTELLIGENCE QUOTIENT WITH READINESS TO START SCHOOL. It is extremely important for parents and teachers alike to understand that an elevated I.Q. does not guarentee maturity or readiness for the work of any particular grade." Less obvious but equally true, a five year old with an I.Q. of 120 or over is not necessarily ready to use this intelligence at a five year old level. The I.Q. can function effectively only when it is integrated with social, emotional, and general behavior and development. "A high I.Q. does not guarantee the child will also be up to his age in maturity--in fact, we have a term 'superior immature' which designates those children who are bright but at the sams time immature."

3. "In obtaining the maturity level of a preschooler we always consider the four separate factors; motor behavior, adaptive behavior, language behavior, and personal-social behavior.... In general, those children whose developmental levels are more or less similar in all four fields may function most comfortably in school and elsewhere. For those children with some single high point--language, for instance--there is always the danger that school and home will expect them to function in all things at this high level. It is this kind of child of whom school personnel often say, unfairly, 'He could do better if he would.' Their reason for saying this is that he reads so well, or that his I.Q. is so high, that he is expected to function equally well in other areas. It is often difficult, in everyday life, to allow for a child's lows as well as his highs."

4. "Through proper placement, 50% of school failures can be remedied or prevented."

5. "Readiness in the cognitive sphere is largely the ability to conceptualize the learning task, to grasp the aim of one's efforts long before achieving mastery of the task."

All the above information and quotes were taken from the book: School Readiness by Francis L Ilg, Louise Bates Ames, Jacqueline Haines, and Clyde Gillespie of the Gesell Institute of Child Development.

Other recommended reading: Don't Push Your Preschooler and Is Your Child in the Wrong Grade? by Louise B. Ames.

HYPOTHESIS MAKING

Professor Mimi Sinclair

(Professor Mermina deZwart Sinclair, until recent budget crises at SIUE a frequent visitor to the Teachers' Center Project, is Professor of Psychology at the University of Geneva. Following is a transcript of a seminar she conducted under Teachers' Center auspices for faculty and students at SIUE on her last visit.)

The title of this talk should be "Preliminary Thoughts on a First Study of Hypothesis Making in Children." Let's call it "Hypothesis Making," okay?

Since the talk was originally announced as "Main Currents in Piagetian Research," I will try to put what I was going to talk about in the framework of that topic. This is a bit difficult because I don't know what you know about Piagetian research and Piagetian theory.

I suppose that most people think of Piaget's theory of development as a stage bound theory--that there are different stages in cognitive development which can loosely be characterized by various ways of functioning and that these stages correspond to the common sense stages that everybody sees in a child.

That is to say, there is the very first age period which goes to about age 1 1/2 or so. Then the child starts to talk and starts to behave in a more coherent way and becomes a pre-schooler. Then at 6 something new begins and at 12 something else new begins. The something new at the age of 12 is more or less the way of thinking that we have as adults; after that what is supposed to be new is merely more new information and better and more practical ways of dealing with problems but not a novel way of thinking.

These are more or less the steps Piaget defined and formalized in a certain algebraic way, but we needn't be concerned about that. Certainly his first works and his writing for a long time were concerned with the idea that the child is not a miniature adult who merely lacks a certain number of things. It is not the case that he learns bit by bit and that all these bits get added to what he was born with. In fact there is some of that, but on the whole it is a total transformation that takes place from period to period. There are periods where the child is in equilibrium where nothing much is happening (where new information is taken in but no revolutionary change in the way of thinking takes place) and there are other times--such as around the age of 1 1/2 to 2, 5 to 7, and 11 to 13--where something profound is happening, where disequilibrium starts to happen and where something qualitativly new happens. The new way of thinking is not new in the sense that the child does away with everything he thought before. Rather, it's more in the way that certain mathematical theories can be fitted, integrated, into new theories. Euclid is not thrown out of the window--we still think in Euclidean terms--but, he has been put into a much larger framework which gives geometry a different quality.

Now the newer line in this type of research is that now these structural periods have been well investigated it becomes possible to look more at the process, that's to say the way children actually look at problems and deal with them across the stages. One can look at something like contradiction. How does a child deal with contradiction in the early ages and how does he deal with contradiction in the later ages? Or generalization, which is a process that goes on in babies, goes on in young children, goes on in adolescence. According to the structure of thought in the various big periods, generalization takes on different forms and different functions.

I think that all this is probably not very comprehensible unless one is really inside the theory, so I think the best thing I can do is give an example of work with Piagetian colleagues in Paris and Genevan co-workers. We have been looking at the development of hypothesis making. I have a certain number of examples which I would like to tell you about. The earliest examples are from children who are 20-21 months old, very young babies indeed, then there are some examples from 5 year olds, then some from 8-9 year olds, and then from 13-15 year olds. Let's see in what sense one can say that hypothesis making is already there at the very early ages and in what sense it has a different nature--is not the same approach to a problem--as hypothesis making is at the age of 14-15.

To make a long story short, in Paris with my colleagues Mira Stanbach and several others who work in a pedagogical setting, we have been looking at babies between the ages of 9 months and 24 months playing on the floor usually (and sometimes around a table) with certain collections of objects.

The situation I would like to talk to you about is a situation where the children have a rather odd collection of stuff. The odd collection is composed of materials that can easily be transformed--for example, some cotton wool, a string, an elastic. There are also things that are pierced-- a big wooden ring, some wooden beads, and some beads made of paper mache. Also, some spaghetti (uncooked), two tubes open at both ends, (the tubes cigars come in), and a couple of sticks.

A side issue of the situation is that we filmed the children longitudinally once a week--there are about 15 subjects that are filmed week after week--and there are two different situations, 1) where the child is alone and 2) where there are four of them together. Another side issue I just would like to mention is that now that I have seen this in a lengthy program, my views on what in Paris are called "creches" (nurseries) for very young children have greatly changed. I think there is something babies under the age of two get out of being with peers which they do not get out of being inside the family. Perhaps at the end I could get back to that.

Back to hypothesis making. Given this collection of objects, and given the fact that the child can do what he likes with the objects (and all we do is film; there is no intervention. Of course, there is somebody behind the child in case the child starts swallowing stuff or hurts himself) all sorts of interesting things happen. The articular behavior I wanted to describe takes place when a child picks up one of the tubes I described. From the age of 14 months onward one of the most general activities of all babies is putting things into other things and exploring certain objects that are made to be containers as against others that seem to be made to be contents. Whenever there is a cup or a box you will see the 13-14 months old start putting things into that.

Now there is no box in our materials, but there are these pierced objects and by the time they are 14 months old they all start putting things through the pierced objects. Their behavior with tubes--this has been seen in quite a number of them and it struck us as something rather extraordinary--is to take up one of the tubes and take up a stick and first of all try to put them together as if they had two sticks and they make sure the two were something different. Then they put down the sticks and put their finger in one side of the tube and put their finger in the other idea of the tube. (What they don't do is what they do much later, beyond 3 years old. They don't look through the tube to see if the whole thing is pierced. It seems to be sufficient to notice the two holes.) Thereupon a stick is taken up and put through the tube. The stick happens to be slightly longer than the tube, so it comes out a bit. It happens almost every time that when they are doing that they don't hold the tube completely horizontal, so the stick slides out and falls to the floor. Now this is a very interesting event to a baby. When it first happens, it surprises him. There are a certain number of behavior indications that tell us that this is a surprise. It's a surprise in the right sense because it amuses him and he wants to reproduce it, so he picks up the stick again and holds his tube the same way, and puts it through again. Now before letting go he already looks underneath, where he now knows it is going to come out. And he is very happy when it does. What we often see is children holding the tube in the same oblique way and pushing the stick through at least 6 or 7 times. Now this is a hypothesis on reality. Reality, if you make the conditions right, is going to reproduce itself. There is a certain regularity. Things are--I don't dare to say "lawful"--but they are regular. They don't do just any old thing at random.

What is more interesting: after having established this regularity, the child will put his hand the other way around and with great trouble put a stick on the other side. Now he is looking for something before having seen it. He already knows, apparently, that the stick is going to come out the other side. So you've got what looks to us as the beginnings of experimentation in hypothesis making and physics. These words have to be used in quotes; the babies establish regularity by recognizing an interesting event and reproducing it. Then when they vary the conditions, they already have some anticipation of what the conditions are going to produce because when they turn their hand around they look this way (demonstrates) instead of looking at the place they looked at first.

Another type of behavior at the same age seemed very important to us. This happened with sort of a grid--the kind of thing you would put a hot pot on--grid and holds. Often the child will put the paper beads into the grid when it lies on the table. Sometimes, when the whole thing gets displaced, they discover that if you lift up the grid the beads fall out because they're smaller than the holes in the grid. This again is something very interesting to reproduce. Once or twice it happened that a child had put in one of the beads that were a bit too big, so when he lifted up the grid the bead didn't fall out; it stuck. This is different. This was not treated as an interesting event. This was treated as a nuisance because the expectation was that everything should fall out. This was a bit of noise or something. However, the child started poking, and the beads still didn't come out, and so he picked up a stick and poked some more and then it did come out. Now, the astonishing fact was that immediately after that he again put the bead in (with the grid lying on the table) and lifted up the grid and once again it wouldn't come out. Now he knew what to do. Straightaway, he picked up the stick, poked at it, and it fell out. Now this picking up on a nuisance event and reproducing the nuisance seemed to us very important. Why reproduce an event that is interfering with your exprimentation? There seems to be only one reason for that: to understand it and to make sure that if you can do it once you can do it twice or three or four times. It is important to get rid of what computer scientists all a bug. This was definitely a bug. All this, of course, is not yet hypothesis making the way we understand it in adults, yet it seems to have some of the same characteristics.

Another interesting point was that it did not look as if the babies with the stick and the tube were trying to find out why this interesting event (the pencil sliding out of the tube) happened. At later ages you will see a child holding the tube horizontal, then little by little making it go more oblique and noticing when the stick comes out. These, of course, are interpretations but it looks as if there is some search for--should I say explanation? When does it come out? This is at the same time is a search for why does it come out. None of the 20-24 months olds did that. Definitely their hypothesis making and experimentation was to have success, not to explain. They wanted to reproduce the interesting events but not to find out why they happen or exactly when they happen.

The next example--I make a big step in ages--comes from about the age of 5. This experiment, done by Karmiloff and Inhelder in Geneva, is again very simple. There are a number of long blocks which can be balanced on a support. A number of the blocks are symmetrical, i.e. the weight is symmetrically distributed, so if you put them in the middle they will balance. Some of the blocks, on the other hand, are weighted with a spot of metal stuck on one side, so if you put them in the middle they won't balance. Now 2 1/2 to 3 to 3 1/2 year olds, if given an example and asked, "Can you make them balance?" just do it. They catch on straightway. They put the other blocks on the support with no trouble. They make all the blocks balance because they have their hands underneath and the (weighted) side that goes down they just push up until it is in the right place.

An interesting group is the 5 year olds. The 5 year olds look at the blocks and say, "I know about that. It should be in the middle." Some of them say, "I know all about that. It's like a see-saw." "It's like scales." "It should be in the middle." So they proceed to put the blocks on in the middle. Unfortunately, this works for certain blocks but not for others. When the weighted blocks are put on in the middle, of course, they go down and they don't balance. Now these children seem to have totally lost the trial and error approach of the younger ones. They say, "Those blocks, they can't balance. They are no good. I don't want them." And the adults say, "Well, wouldn't you like to try? It'll work," and the children say, "No. It should be in the middle. I pick it up, look and put it in the middle, look, and it doesn't balance. No good."

These children have a theory. That's different from just having ideas. They've got a theory and the theory is okay but the objects aren't. And there is just no way for the children to get back to trial and error.

I won't go on about this experiment too long but at later ages--at the age of 8 or 9 or so--they will be ready to start working on the blocks that were no good for the symmetric theory and they will go back to trial and error.

But perhaps you can see what I think is an important issue here: if you just deal in success on a test, the 3-4 year olds do much better in this particular situation. They can balance all the blocks. They succeed. The 5-6 year olds just don't succeed. Obviously, it's not because the 5-6 year olds are dumber or less developed than 3-4 year olds. It's because the older child works on theories, something totally different from just trial and error. It isn't stupid, by the way, not to want to let go of a theory. If we let go of our theories at the first sign of contradiction, we don't get very far. The good idea is to stick to your theory to its limits and then to look at the exceptions. The exceptions are often very important.

The next two examples are probably the most interesting because they fall in the ages with which all of you are more familiar with. They have to do with a well know Piagetian task that has to do with volume conservation. Does everybody know about that? Who does not know about conservation tasks? Nobody. Great. The conservation tasks give some mysterious results.

As you know, if you have the famous two clay balls and they are just the same--there is just as much clay in the one ball as in the other--and then you roll one into a sausage and ask a 6 year old if there is just as much clay in the sausage as in the ball, the 6 year old may still say, "No, there isn't, because your sausage is longer so there is more clay in the sausage than in the ball." Or if you break one of the two original balls into little bits, the 6 years olds tend to say, "No, it is no longer the same amount of clay. Look at all those little bits. Look at the big ball. No, it couldn't be the same." (This could happen at age 5, or 7, or 8; the ages are by no means fixed.)

A couple of months later they say, "Of course, it is the same because after all you didn't take anything away and you didn't add anything. Why should it be more or less? It looks very different--it's longer but it's thinnner." You know these arguments.

Let me trot out my famous example to give you some feeling of why children think of non-conservation, which is a peculiar idea. If I have two raw eggs and they weigh the same, and if I boil one of them, will it weigh the same as the one I do not boil? There is no need to come up with an answer, but I would like you to think about what is going on in your head. You are asking yourself questions. The answer is not obvious at all. Now, this is the feeling a child has when you ask him the question about the amount of clay in a ball of clay. It has nothing to do with simply looking at the length of clay. There is something funny there for the child which for us isn't funny when you just change the shape of something but which does become funny when you do things like boiling. You don't feel very comfortable. You'd like to ask some questions. I am not going to answer the question, by the way. It doesn't matter. But in all the questions on conservation the child has the feeling you had just now, this feeling of, "There are lots of things involved. What could it be? What's the main thing I have to think of?"

So we are at the point where the 6 year olds on the question, "Is there still as much clay in the ball as in the sausage?" says, "Yes, sure, nothing was taken away and nothing added." Now ask the same child an hour later about the balls of clay, one of which was rolled into a sausage or broken into bits but ask the question in terms of weight. Do the two still weigh the same? The same child who said nothing taken away and nothing added when you ask him about the amount of clay will now say, "It doesn't weigh the same. All those little bits?" (Or that sausage?) No question. No way. It doesn't weigh the same." Now this is a bit mysterious because he only had to say the exact same thing he said in the first place to get the answer right. He is clearly already capable of thinking that there is just as much clay because you didn't add anything or take anything away, etc. Why doesn't he do that when you talk about weight?

Now go a step higher and take two balls and take two glasses of water and do the same thing--sausage or bits--but ask about the rise of the water level. First you put in the two clay balls and the child sees that the water level goes up to the same height. You take them out and you make one into a sausage (or bits) and you say, "Now if I put them into the water, will the water level go up to the same height?" The same child who gave the mature answer for the weight question will once again say, "Of course it doesn't rise to the same height. No question."

This was [illegible] age where I wanted to give an example of hypothesis making. You take 8-9 year olds who have no trouble with the weight question and you do it with the water jars. You use two clay balls, one of which is transformed. (Or you use metal cylinders made of different kinds of metal--same size, different weight. Or you use metal cylinders same weight, different size--as you can see, you can play around with that.) Now these 8-9 year olds, as I said, will say that the clay balls do not displace the water to the same level. And then we put them into a sort of learning session, and we actually put the transformed clay into the water or the child does it himself. Lo and behold, he sees that he is absolutely wrong, and says, "Oh, that is not right."

Now what do the 8-9 year olds do after quite a number of demonstrations of this kind? They start spouting hypotheses. They say, "Maybe some water got in when you made it into a sausage." "Maybe it is easier for the water to get in when there's little bits than when it's a round ball." "Maybe the one went down quicker than the other." Maybe the ball presses heavier on the water than the other one" etc. etc. In fact, what their hypotheses come down to is that they think of density, they think of speed of falling, they think of pressure, they think of surface area. They think of a whole lot of things that are absolutely not stupid. It is simply that the are irrevelant in this particular situation. You can keep on as long as you like during these sessions. and they keep on thinking of weight as the important factor for the determination of the water level.

As long as you have two objects that are different in weight, they will say that they do not weigh the same so the water won't go up to the same level. And if they are shown that it does go up to the same level because they happen to be the same size. they come up with all these explanations. Strangely enough, they are even capable of compensation. That is to say, if you have a heavy cylinder that is smaller than a lighter one--and they are shown all this before you start putting it in to the water--they will say, "Well look, maybe now it will go up the same." And you say, "Yes, how come?" "Because the bigger one is lighter and the smaller one is heavier. so it could well go up the same way." "The heavier one will make it go up higher and the bigger one will also make it go up higher."

Now an older child will never think that you can compensate for volume by weight or for weight by volume, but for these children this is a possibility. In a sense this means that they have already pulled apart weight and volume (weight and size, if you like to talk in children's terms) but their theory is clearly that weight influences the water level. You can add other hypotheses to that but you cannot change it. It is absolutly necessary that weight influences water level.

Now let's move up to the 10-12 year olds. (Again, the ages are not absolute.) For them the problem is as simple as anything. As far as the clay ball vs. the clay sausage or clay bits (or the clay pancake, another variation) goes. no problem. You didn't take anything away and you didn't add anything. so the water will go up to the same level. They won't even admit the necessity of checking. If you say, "Shall we look?", they say, "Well, if you want to, but there's no question about it." And they give the same answer for the cylinders of different weight. "It takes up the same room. Would you like to test it?" "No."

Now you go to the 13-15 year olds and once again you get the phenomenon of what psychologists are now calling U shaped curves. It looks as if these children regress because in a sense they start behaving like the 8-9 year olds. (It is a bit difficult because it gets mixed up with the children's school knowledge. You get a number of children who start out by saying. "Yes, I know all about that. It was some Greek scientist in a bathtub.") Then you start with two cylinders of the same size with one much heavier than the other and you get (in different terms because they are more sophisticated in their terminology) very much the same thing as the 8-9 year olds were saying. For example, "This one (the heavier cylinder) will make the water go up higher. It's heavier The weight of the cylinder is a body. The heavier it is. the higher the water goes up. It exerts pressure on the water. you know. The heavier one exerts more pressure than the lighter one." This sounds exactly like what the 8-9 year olds had been saying. There is one difference. This child says that before any demonstration has taken place, whereas the 8-9 year olds come up with the idea after a few demonstrations where his theory has been contradicted.

Moreover, many children went on to say, "Come to think of it. I really think we have to look. I don't think I can just think about it and tell you. I think we have to try it out." So not only are their hypothetical ideas now possible to be verified. but also these children know how to translate their ideas into an experimental situation. After having said that the heavier cylinder will make the water go up higher because it exerts more pressure, they say that the only way to know is to take two objects the same size and one heavier than the other and put them into the water. If it comes to the same level. we will know that the idea was wrong; if it indeed goes up higher with the heavier one. then I know my idea was right.

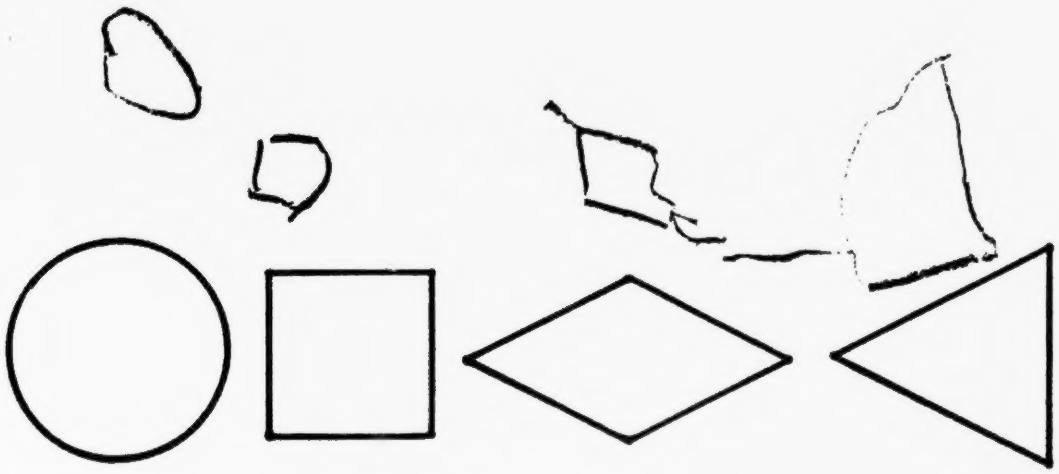
In the situation with the clay ball and the bits of clay, they will devise another situation. They say, "There are little bits of clay, and it seems to me that they might well stay suspended in the water. What would that do to the water level?" Then they say. "Well. let's have a look. I'm going to make very, very little bits, because if the water level still goes up as much with the tiny bits, then I'm sure that breaking it up won't matter."

So to get back and to make a long story very short, the 8-9 year olds have the idea of weight. and they will not let go of the idea. When the weight theory is contradicted. they add some other ideas such as pressure, permeability, etc., to account for the contradictions, but that doesn't make them cancel out the weight theory idea. They cannot say in this situation that weight is irrelevant. Weight is relevant. It might be modified by some other factors, but these other ideas only come up after contradiction and do not lead to the child's inventing a situation where the idea could be checked.

The 10-12 year old approaches the problem as if it weren't really a physical problem but as if it were a logical problem. He just says, "You didn't take anything away and you didn't add anything. so we don't even need to look." He doesn't even think of the fact that between water and the solid there might be some funny things going on. (If it weren't water but alcohol. even adults might not be so sure.) But the 10-12 year old won't think of that. He will solve the problem logically; nothing taken away and nothing added. so everything is the same.

The 13-15 year old has not lost this capacity. but he had acquired such a sure way of organizing his world in a logically coherent way that now he is quite ready to think of the funny things that can happen in chemistry and physics. He is also quite ready to look at his theory. His theory is no longer something that merely leads to prediction, as it was with the tiny babies and with the 6 year olds and with the 8-9 year olds. With them the theory leads you to predictions. If some of them are right, you just forget about all the rest. You can never go back on your theory.

At the age of 8 or 9 in these examples you can add other hypotheses to explain the contradictions to your theory. But it seems to be only in adolescence that the theory itself can be seen as a collection of hypotheses, and that the assumptions behind the theory can be questioned, and that the theory is subject to verification. Moreover, the adolescent now knows how to set up a verification situation. And finally, the evidence of this verification situation is conclusive.



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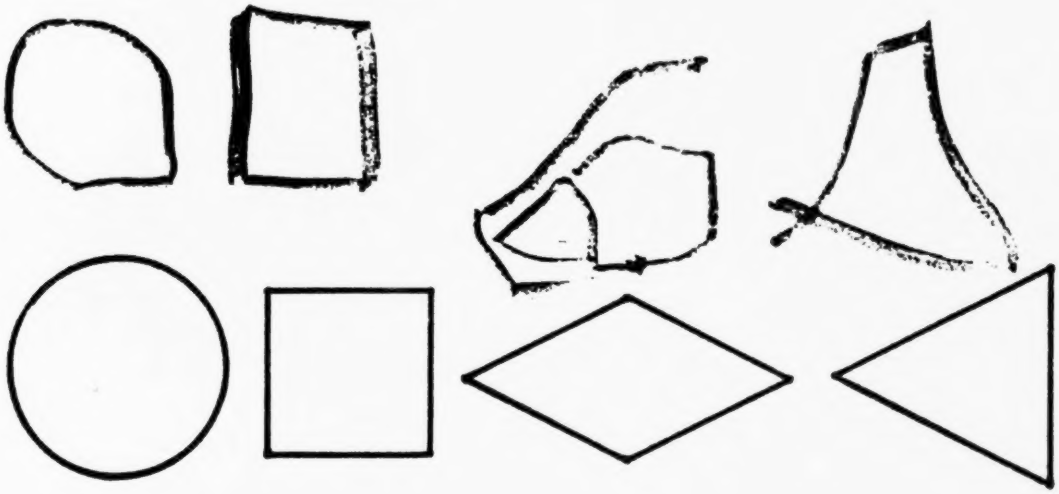


4

THE PLIGHT OF A TEN-YEAR OLD

Jana Ashford

On a whim one night, I asked my children if they would like to blow some bubbles. I had in mind a lesson about what can be learned from blowing bubbles. We put some dishwashing liquid in three glasses and added water. Then, we each took a straw and blew into the solution. Bubbles, bubbles, everywhere. They "grew" all over the kitchen table. I showed my children some tricks I had learned in my class, and they were thrilled. Then, my 10-year-old son, Dan, began experimenting on his own. Some of his ideas were:

1. Poking a needle into a bubble to see what happens.
2. Placing a bubble in the freezer to see if it freezes in a bubble shape.
3. Combining one of my bubbles with his bubble and then stretching it out to see how far it grows.
4. Connecting bubbles into a "chain".

After an hour of this excitement, I announced that it was time to quit. "Do we have to?" was Dan's response.

Is this the same 10-year-old with learning disabilities who cannot stay "on task" at school? Is this the child with two C's and four D's on his last report card? Is this my son, who will find his place in life, I've been told, "working with his hands"? As the mother of a learning disabled child, I've heard this for the past five years. His teachers do not see the creativity he uses at home to get his brother into trouble, or to get attention from his parents. They do not see him use his imagination when he is deeply engrossed in a game of cowboys and Indians with Playmobile People, or have races with his Matchbox Cars. What is most important in life, memorizing and then forgetting, or being creative and resourceful when the need arises?

Dan has trouble comprehending what he reads. In school, the subjects of Social Studies, Health, Science, and of course Reading, are all dependent on how well he understands what he reads. There are many different ways of learning, and reading is only one. I have resorted to telling Dan that life consists of more than schooling--because I fear his self worth is in jeopardy.

My hope is that one of these days Dan will find a teacher who realizes the potential he has, instead of concentrating on how poor his sentence structure is, or how he forgets to capitalize cities. Maybe this teacher will see the real child--a delightful, inquisitive, creative human being.

YIKES

Shannon Myers

In Dr. O'Brien's own words, "Yikes." We talked about a lot of things in our class. Out of all of those "things", the one that really hit home with me is the plain, simple, obvious fact that children are not alike in their thinking. It is such an obvious fact. After all, children do not all look alike. Why should they all think alike?

When I was in elementary school, we had to do math problems a certain "correct" way. Sometimes it seemed so much easier to do some of the problems a different way, but the teachers would not allow it because "It has to be done this way.". I grew up thinking that there was one correct way to work every math problem. Well, when I arrived at O'Brien's math class, it was proven to me that there is no one way to do math and that not all children think the same way or do math the same way.

During one of my child watching activities, I watched six different kids. All six of these kids looked different. They all talked differently. They all dressed differently. These kids were unique individuals, but for some reason I expected that they would all do the activities the same way. They didn't. I gave one little girl fourteen pennies to count and she put the pennies in two rows of seven pennies as she counted them. Another girl touched each penny and scooted it across the table as she counted it. Still another girl picked all of the pennies up in her hand and tossed each one into a pile as she counted. I gave two heaping handfuls of pennies to a thirteen year old girl and asked her to count them. When she finished, she said, "There's a dollar and ninety-two cents here."

We did many other activities in class which pointed out the fact that children are unique. During our last class session, we worked some math problems with Cuisenaire rods. We saw as we went around the room afterward that no two people in the room were working the problems the exact same way. If we as adults do not do and think the same way as each other, why do we expect children to think the same way as one another?

This may seem like a "trivial" issue to write about, but there are many educators and people involved in the education of children who have not arrived at this conclusion. And as Dr. O'Brien says, "YIKES."

BEAD STRING ARITHMETIC

Cecelia Zavaglia

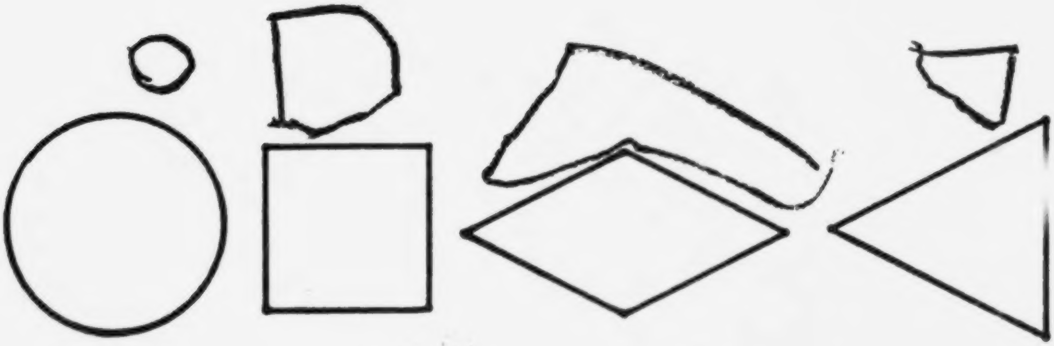
After working with bead counting strings in class I was curious to see how my six-year-old son would use them. The following relates one activity we did together which produced some rather surprising results.

We used a string of 100 beads with the pattern 10 white, 10 red, 10 white, 10 red and so forth to 100.

The first thing I asked him was how many beads were on the string. He quickly recognized the beads were grouped by color in groups of 10. Then he counted by 10's to 100. Next I asked him to show me 10 + 3. He moved one colored section for 10, then counted and moved 3 more. Next we did 16. He left the original 13 and counted and moved 3 more. Next I asked him to show me twenty-one beads. He left the original 16 then moved 4 reds and one white. He was apparently using the colors as a key. I asked him to show me 50. He left the 21, moved 9 white to make 30, and counted by 10's to 50. I asked him to show me 47. This is where we hit a snag. He took away 10 then 3. I asked him to check to make sure there were 47 beads. He counted 10-20-30, called bead #31 forty and counted by ones to 47. I checked him three times and each time he repeated the procedure exactly. Then I asked him to show me 57. He counted from his "47" 8 then 2. I put the beads all back together again and asked him to show me 47 again. He repeated the same procedure as the first time (10-20-30), called bead #31 forty and counted by ones to 47. We could not seem to get past his stumbling block.

The following week I decided to work with him again on this same project. This time my husband videotaped the proceedings. We were able to resolve his conflict, and the results can be seen on a copy of the video tape available for viewing from Dr. Tom O'Brien.

(Note from TO'B: The tape is super. Come take a look.)



Some Good Commercial Games
Doris A. French

Busy teachers on limited budgets might be interested in examining some inexpensive math games put out by Gabriel. These games are available at most discount stores. I will describe four I have in my classroom, but there are many others put out by this company.

1. Pythagoras
   This game consists of seven geometric shapes. The object of the game is to rearrange these shapes into 179 different designs. It includes a Challenge Sheet.

2. Over-n-Out (a number concentration game)
   There are two sets of numbers 1 to 15. Each player arranges his set in random order, face down, on the game board. Taking turns, players turn up numbers looking first for 1, then for 2, and so on in order. If the number chosen is out of order, the player replaces it and tries to remember its place for future use. The first one to get all numbers in order wins.

3. Hi-Q (All-time favorite solitaire game. Quiet. Develops strategy)
   1. Place 32 pegs on board leaving the center hole open.
   2. Each move must be a jump, either horizontal or vertical. Each jumped peg is removed from the board.
   3. Multiple jumps are allowed. No diagonal jumps are allowed.
   4. The object is to remove as many pegs from the board as possible. Scoring chart scores 1 left in the center-Genius; 1 left any place on the board-Champion; 2 left and so on.

4. Gridlocks
   This game has a plastic grid with a random arrangement of shapes (squares, circles, and crosses). Tiles of these shapes are to be arranged to cover the grid. These tiles are rectangular (with two shapes) and L-shaped (with three shapes). covering the grid completely with no shape left uncovered is a challenge. There are 50 combinations possible using various titles.

All of these games can be played alone or with a partner. They are quiet games. They are easily understood by my second and third graders but would challenge even adults. Most can be played in a short period of time. They all cost less than five dollars and are made of sturdy plastic.

MAKING NUMBERS MEANINGFUL

Beverly Bonkoski

I had the distinct pleasure of participating in the fall edition of the Teachers' Center project and came away from it with a change in heart and, more importantly, a change in perspective in my philosophy of teaching mathematics to children. To say I have grown is a most significant statement because I come from an elementary school background that produced "tin soldiers" fostering "assembly-line" learning. "What is mathematics?" or "What do all these numbers mean?" are questions I never would have pondered had I not joined the sessions with Dr. O'Brien and Mary Steffen, an elementary school teacher from the Ferguson-Florissant School District. For those of us dedicated to the growth and nurturing of children, it is a must to participate in one of these sessions and this paper is a way to convince those who have not done so.

This paper deals with observations I made while myself and the other participants explored the use of Cuisenaire rods in making the learning of numbers a meaningful experience for adults and more importantly for children. Do children, or adults for that matter, truly know what a "7" is? Do they know that a "7" can be found in more that one way? Can they lift that symbol off the page and "see it" and feel its' worth? I say "yes" they can and this paper will hopefully help to encourage you to see why. If you are uneasy about the thought of using such manipulatives, please read on, for you will see how they can be understood by some of us who were equally uncomfortable in exploring them.

There were two factors involved in my own change in attitude and thought. One occurred when I observed Mary Steffen using the Cuisenaire rods to teach place value to her fifth and sixth graders. Another occurred as we began to explore the rods in our Teacher's Center session. Our session not only supplied a productive experience but we learned many other valuable ideas that have as much to do with teaching math as numbers do. The question is: Can we make numbers tangible for children? Read on and find out.

As I mentioned, I had the opportunity to observe Mary Steffen at work. Her classroom is designed for team teaching and focuses on an open, free moving environment, or perhaps I should say a child-centered environment. It was the first time I was in such an environment. At first I felt a bit lost and somewhat overwhelmed. I decided to sit in the background and "take in" as much as I was capable of in one small visit. I was fortunate to observe Mary using the Cuisenaire rods to help the kids develop the concept of place value. While I could only observe for one hour, I learned a lot about using specific teaching strategies. Mary's open-ended questions like: "Is there only one way to construct this problem?", "Are you sure?", "How do you know?", "Can you show me?", allowed for many explorations with numbers and her patience (waiting time) allowed the children to use as much time as needed to make discoveries and more importantly to feel a sense of security in the solutions to their problems. It wasn't long before the hour passed but this was at least a begining for me. I'd laid the groundwork for our study of the rods in our next teacher's session. I would encourage anyone who is curious about the rods to observe a teacher such as Mary.

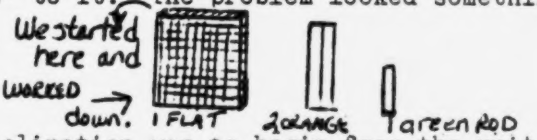
As we began exploring the rods in our teacher's session, I realized that I had indeed learned a lot from my visit with Mary. The realization occurred when I was helping a fellow classmate determine the number value of the rods and how he could use them to construct numbers. I found myself asking him questions that let him discover for himself what the rods represented (numbers) instead of directly telling him. I think he reached a better understanding of what he was doing because he made the discoveries himself. I listened carefully to his explanations of his discoveries so I could be sure he was secure in his number constructions. Asking him to show me the steps to his solution, helped to confirm the validity in the steps he used.

We then explored the rods further in groups. I would like to add a general observation. Working in these groups made our experience much more successful and pleasurable. Group cooperation and sharing enhanced learning and we felt much more secure because we knew if we got "stuck," someone would help to "unstick" us. Another observation comes to mind as far as working with numbers (rods). I was actually able to get the "feel" for what a number "7" is or what a number "27" is. You are able to "see" the number and to see what places they hold. The rods make numbers a tangible entity, not just a flat symbol on a piece of paper. These explorations then helped to make numbers and their operations and concepts such as place value much more relevant and manageable. You are taking part in the actual "working" of numbers and the actual function of place value or addition. The process becomes active, not passive.

One of the most significant things I learned is to give the children (as we adults were given in our session) the time and trust to handle the rods and make their own discoveries. In this "discovery time" you are allowing for the realization that the "means" to an answer are many. Children can come upon many variations as we did in class. There is no "one right way" to solve a problem like: "Can you show me '7'?" By allowing the sharing of different possibilities, you are also allowing children to build richer reservoirs of information. The more variations the better but always allow for an adequate amount of time for the alternatives to be born. In other words, never stop at one answer, make the search for solutions a continuous process. Don't put up a "stop sign" as soon as THE ANSWER is found.

I was most thankful for our group sharing when we were presented with the problem of dividing the number "11,111" by "15." We first built the number "11,111" and were delighted to actually see the magnitude of such a number. I really got stuck with the division problem. Then Lisa (one of our group members) said: "I have an idea, let's just build fifteen piles and distribute what we have to see how far we can go." We thought that this would be a gGGd start. We worked very meticulously and managed to construct our problem. We tried to evenly divide up our remainder of eleven but just couldn't. I think we all wanted the problem to work out evenly, so we really tried all kinds of crazy things - but had no luck. Yet, thanks to my group, I didn't remain "stuck" and was "pulled into" the problem by my coworkers, and we all worked it out together.

I also learned an interesting way to add on a new number to an existing number. In other words, we had the number "124" and were to add the number "478" to it. The problem looked something like this:



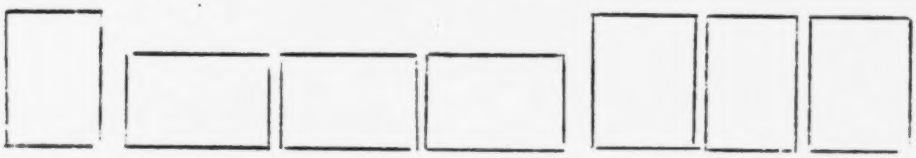
My first inclination was to begin from the units place and work upwards. Lisa suggested working from the hundred's place downwards. We tried it and all felt comfortable with it. I'm glad Lisa made this suggestion because it stopped me from doing the problem in the "same old way." Lisa worked the addition from the bigger numbers like so:

$$\begin{array}{r} 47 \\ +38 \\ \hline \cancel{7}85 \end{array}$$

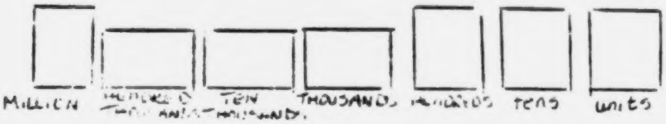
When working in groups, you can begin to find new solutions to problems and these solutions can lead you to economize your problem solving.

Aside from the tremendous value I found in working in groups, I would like to comment a little further on the actual use and manipulation of the rods. We were realizing as we were constructing our numbers that we were actually "seeing" and getting the "feel" for how small or large a number is. Take the number "10,000." If you write this number on a blackboard for children, what can this tell them about the size of this number? It only looks like a "1 with a bunch of zeros". Yet if you actually build the number with the rods then you are giving children (and adults) a true picture of what a "1 with a bunch of zeros" is.

Developing place value with the Cuisenaire rods allows you to particpate in the true "inner workings" of this concept. This is how place value was presented to us. Seven different colored pieces of construction paper were arranged on a table like so:



We then had to decide what "places" the construction paper represented. A question like: "Where would you put a '2'?", began our investigation. Once that task was completed, we began building numbers and placing them on the proper pieces of construction paper (or proper placeholders). We ascribed the following labels to the construction paper:



By turning the paper sideways after the first three pieces from the right, you can also see clearly where commas are to be placed. Questions in the following sequence, led us to greater understanding of place value.

1) Can you make "5" in the most efficient way?
2) Now can you make "5" more?
3) Now add the number "29".
4) Now add the number "83".
5) Now add the number "478".
6) Count how many piles you have at each place.
7) Write the digit to represent the number of piles at each place.
8) What number have you constructed?

The method described above allows you to actually move the numbers around so that their places are effectively filled. You can also see why, if you have "9" units in the unit's place and add "10" more units, there is a place next-door that is made to hold the overload. It truly compartmentalizes place value.

A final question may be: "Did I learn a lot from our Teacher's session with the Cuisenaire rods?" Answer: "You bet." Everything from group cooperation and sharing, effective use of questioning (open-ended), to the specifics of learning how to manipulate the rods. I realize that this is just the "tip of the iceberg," but it is a substantial beginning, and I feel confident in using the rods on my own or perhaps with others who have knowledgeable background in their use.

Pilgrims

As is widely known, Teachers' Center participants climb on Monkey Bars, dive into swimming pools, knock on neighbors' doors at dinnertime -- all in the interest of interviewing children (We call it childwatching) to see how they construe the world. The present material concerns the question, "What is a pilgrim?" The question was asked of local schoolchildren around Thanksgiving, a time when classrooms are painted with pilgrims.

What would your (adult) answer be to the question, "What is a pilgrim?" You might dip back into what you know from Chaucer or Thomas Merton or medieval Roman history to say something like, "A pilgrim is a person who travels, physically or mentally, in a search, often for religious purposes."

Here are some schoolchildren's views of "pilgrim." Aside from entertaining and charming the reader -- which children's responses often do -- the following responses give valuable information on how children see the world, what they make of what they are taught, and how they interpret and intermix the various elements of their experience.

What is a Pilgrim

A Pilgrim is a person who traveled over with Columbus to try to find land. And that they did. They fought the Indians. They built log cabins and lived in them. They sailed across the ocean in the Mayflower. They had food to eat but they had to work. They dressed in long dresses and bonnets. And the men dressed in pants and shirts (not T-shirts). They dressed in nice shirts. And that is how the Pilgrims lived.

* * *

A person who lived long ago and was afraid of Indians and liked turkey.

* * *

A pilgrim is a person who used to be some kind of a person who lived long ago. On Thanksgiving the pilgrims had a Thanksgiving feast. And that's the way the pilgrim story goes.

* * *

Once upon a time Columbus and some people sailed on the Mayflower to explore new lands (if they ever found the land that is) well when they finally saw the Plymouth Rock they didn't know it but they discovered America. Well when they were almost settled then they came the Indians started. Well anyway a pilgrim is a person who liked to explore and were black usually and were the first people to live on America. THE END

* * *

It is a person from America that has went to an island and indians taught them how to cook certain foods.

* * *

It is a man who lived long ago.

* * *

A person from long ago that came to America along time ago.

* * *

A pilgarin is a person that discoved thanksgiven a long time ago.

* * *

A pilgrim is something that has a hat and they love getting turkeys and if there was no pilgrims there wouldn't be no thankgiving and the pilgrims.

* * *

A pilgrim is a man or women who traveled to America they traveled over sea's they traveled on a boat named the mayflower they traded gun powder beads and other tools for money and they used the money to raise crops.

* * *

The people who met the Indians on Plymouth Rock. And they floated over there because they didn't want a ruler.

* * *

A pilgrim is .... little short people that wear brown and black close. They taught the Indians how to make corn. The pilgrims found the United States. If it wasn't for the pilgrims we wouldn't have thanksgiving I'm so glad for pilgrims. Aren't you?

* * *

A prilgrim is something from ages ago and they wear black clothes. And they have brown hats. They landed on the Plymouth rock and when they settled on America and everyone they saw thought they were Indians and after awhile they became friends with the Americans.

* * *

A pilgrim is a person who discovered America. And knew the Indians real well.

* * *

Pilgrim - A plilgrim is a person with other people that sailed across the ocean on three ships and landed on America.

* * *

A pillgrim is a person that stays with a group of people it can be a boy or a girl or a woman or a man. Pillgrims taught the indans how to plant corn and other things. Pillgrims discovered the Amircan history.

* * *

A Pilgrim is a person that lived a long time ago. They are the people who discovered America they made friends with the Indains the Indains shode the Pilgrims how to plant they even discovered Thanksgiving. Thats what a Pilgrim is.

* * *

The pilgrims were the first people to discover the United States of America. First they built a whole bunch of log cabins and then they had a feast. They were the first people to live in the United States of Amrica.

* * *

A Pilgrim is a person that lived long ago. A pilgrim lived in the East and had an axcent. And they stepped on the Plymouth Rock.

Megatrends - Book Review

Doris French

Megatrends has been described by Senator Gary Hart as . . . "an insightful analysis of the political, societal, and economic currents that will shape our future." The author of this book, John Naisbitt, describes it as a book "about a new American society that is not yet fully evolved."

The readers of this book, according to Naisbitt, are living in the "time of the parenthesis, the time between eras." Although a time of uncertainty, it is also a time of great opportunity. It is his purpose, in this book, to "describe the environment in which the reader will consider the decisions of life: what to study; the right job path; where to live; where to invest money; etc."

This book focuses on ten trends that Naisbitt feels are shaping our new society. It is his premise that . . . "the most reliable way to anticipate the future is by understanding the present." To identify these trends, he has used a method called content analysis. For twelve years his staff has monitored 6,000 local newspapers each month. Analyzing the local action in cities and towns across the United States has helped him trace and evaluate important issues and trends.

Naisbitt presents his material in a concise, easy-to-understand format. He does not sensationalize or over-simplify. The reader does not look with panic at an impending new world, but rather sees the events of past years that have molded exciting trends offering unlimited opportunity for those who care to seek and participate.

The following review of this book is a short summary of each of the ten trends. The first megashift has been from an industrial to an information society. Brain power is used to create instead of physical power. "Now knowledge is mass produced and it's the driving force of our economy." People interact with other people rather than with nature. "Computer technology is to the information age what mechanization was to the industrial revolution."

The second trend has evolved from the use of advanced technology. "Whenever new technology is introduced into society, there must be a counterbalancing human response - that is, high touch - or the technology is rejected." People continue to have a need to interact with one another. A highly personal value system is developing to compensate for the impersonal nature of technology.

The United States moving from a national economy to a world economy is the third trend. "First, we are shifting from being an isolated, virtually self-sufficient, national economy to being part of an interdependent global economy. Second, we are giving up our former role as the world's dominant force and becoming a member of a growing handful of economically strong countries." Third world countries are taking over the industrial supremacy once held by the United States. The United States must meet the challenge to take the lead in "the innovative new tasks of the future."

The fourth trend is a shift from short term to long term planning. Companies have become concerned with the long-range future of business with less emphasis on immediate financial goals. Short-term solutions no longer work. In education, the short-term considerations of completing our training at the end of high school or college has shifted to lifelong education and retraining.

America is becoming a decentralized nation in politics, in business, and in our culture. Americans are moving away from old industrial cities, spreading out to small towns and rural areas. Diversity has become the rule; differences, rather than similarities, are stressed. Decentralization creates more centers which means more opportunities and more choices for the individual.

Americans are beginning to relearn the ability to take action on their own. They are finding that they can no longer rely on institutions and government to provide basic needs. The sixth trend has been toward self-help and self-reliance in areas of health, crime prevention, education, and consumer co-ops.

Another trend is from representative democracy to participatory democracy. "Citizens, workers, and consumers are demanding and getting a greater voice in government, business, and the marketplace." The key issue is that people whose lives are affected by a decision must be a part of the process of arriving at that decision. Political action is at the local and state level. Representative government is losing its power. In business, the trend is toward greater worker participation and employee rights, more stockholder activism.

The eighth trend involves a shift from the pyramid structure of hierarchy to networking. The cold, impersonal nature of bureaucracy annoyed people. They began talking to one another, seeking solutions, sharing ideas, information, and resources. Networking is simply "connecting people with one another to foster self-help, to exchange information, to change society, to improve productivity and work life, and to share resources."

A significant trend of the 80's is that for the first time in the history of the United States, more Americans live in the South and West than in the East and North. According to Naisbitt, "we do not fully understand the significance of the restructuring from North to South." A national search for energy has led to the rise of the South and West. The trend toward decentralization has led people and business to move away from concentrated industral areas. This decentralization is not all bad or all good. The quality of life is improving as people leave crowded areas. Whereas fast-growing areas complain about pollution, high prices, traffic, water and sewer problems, Florida, Texas, and California lead the nation in the growth of population and income.

The final megatrend is the growth of multiple-option society. Individuals have greater opportunities for self-expression in education, religion, the arts, in work, and in the marketplace. No longer do we have the "traditional" or "typical" family structure. Women are breaking away from traditional female roles. Cultural diversity is encouraged; the melting pot theory is no longer taken for granted.

Thus, Naisbitt has vividly described the world in which we, the readers, are now living. It's a time of challenges and a time of questions, a time filled with opportunity. The best conclusion is found in the words of the author himself. "My God, what a fantastic time to be alive."

HOW TODAY'S READING SOFTWARE CAN ZAP KIDS' DESIRE TO READ

Susan Ohanian

(The following article, reprinted with permission, comes from the November - December, 1984 issue of Classroom Computer Learning. Copyright Classroom Computer Learning 1984.)

Most reading software is foolish and impudent, an odious endeavor. And the mistake is right up front-in the endeavor itself, not in the execution. I like clever graphics as well as the next person, and today's software certainly drills with pizzazz. But what I find foolish is the basic premise-that reading can be achieved by drilling students on discrete skills.

Plenty of folks are fond of constant blends and their assorted kin. A skill is comfortable. It is easy to spot; it can be measured, charted, graphed, put in a data bank, brought out on parent conference night. Certainly these skills are nothing new and I do not blame the computer parvenus for their existence. But neither do I thank them for making things easy for the educational bookies who insist we can know a kid by the numbers in his folder.

Folks who play the educational numbers game never ask what a collection of 1,392 of these skills is good for, what the kid should do with them. Acquisition is the only goal. Computers, which allow isolated skills to multiply faster than the biblical tribes, merely encourage the foul bureaucratic impulse for collection, storage and retrieval. I can only express my gratitude that, when I taught reading in New York from 1969 through 1983, I was unaware that the New York State Education Department had 1,800-plus reading objectives stored in its computer bank.

CONSONANT BLENDS THAT DANCE A JIG

People ask me what I have against the consonant blend and other wonders of phonics. Absolutely nothing. I show my students that these devices are helpful-but only to help them read books, not to fill out skill sheets. In my years as a reading teacher, I watched any number of fancy skill-drill programs pass through the coordinator's office. But those who offer only a choice of how skills are to be presented-filmstipped, tape-recorded, televised or computerized-offer no choice at all.

Bureaucrats seem ever able to find thousands of dollars for up-to-date ways of delivering the same old skills at the very time they cite budget deficits as the reason for laying off librarians. A computerized skills checklist may be convenient for justifying one's application for federal monies (to purchase more electronic checklists), but we must demand more of our reading paraphernalia. We must insist that it be good for kids. We teachers must not relinquish our savvy about kids and how they learn to read.

Disk-drive partisans justify their use of computers by bragging about the bonanza of "immediate feedback." If one can't think of anything else to say about a program, there is always "speedy correction." And yet thoughtful scholars such as Frank Smith caution us against being too quick to offer feedback. If a child is to become a reader he must be willing to take risks. Do we want to be too quick to label such risks as error? I, for one, am not grateful to the guys who bring me the nasty combination of silly questions and speedy corrections. I find no charm in immediate numerical gratification.

And then there is "impersonal feedback." Now there's a notion to make a granite wall weep. I want my students to become personally involved with books- to puzzle over them, laugh over them and, when necessary, to get angry with them. For this to happen, I need to be passionately involved. I need to offer myself- my intuitions, experience, knowledge and, yes, also my pleasure, my ire. Better I should wrongly holler at a kid than abrogate my teaching role in the name of impersonal feedback. I did not become a teacher in order to replace enthusiasm with anomie.

But then, I don't see reading as a steady progression along carefully sequenced rungs of skill development. Reading has always seemed a more pesky enterprise to me. We must recognize that the hucksters of skills systems have a disarmingly optimistic view of skills but are propelled by a dismal view of children. Reading cannot be handed out like scratch-and-sniff stickers. The skill-and-drill fix is about as helpful to children's intellectual development as sucking on Jujubes.

SKILL-DRILL THRILLS...AND CHILLS

So how do we keep our feet firmly on the rock of pedagogical principle when faced with so many reading programs on disk? How do we find the few that are worth-while? We can't rely on software reviews. They seldom measure the electronic hugger-mugger against, say, *Charlotte's Web* or *King Arthur* or *Never Cry Wolf.* Instead, reviewers say, "This is better than a workbook." Paltry praise indeed. The students shouldn't be wasting time with a workbook either.

No, we have to look at the stuff ourselves. I recently did that and I doubt that anyone could possibly believe what I say. You had to be there. The dim-wittedness offered up by much current software in the name of reading comprehension and thinking skills is quite amazing. Let it suffice to say that there exists a junk category of software totally fascinating in its foulness. I spent hours punching in wrong answers just to revel in the stupidity of the "explanations," except that I often erred in my anticipation of errors and got answers right that I intended to miss. (That meant starting the program all over, since I was determined to see every one of the wacky explanations.)

Anyone who is in awe of the technological breakthroughs in education should work throught the 815,000 ugly little sentences generated by one program-a program that purports to teach 38 rules for capitalization. This software operates on the principle that if the kid doesn't get it the first time, them make him try the same thing 814,999 more times. Or consider Vocabulary Development, Phonics in Context, Spelling Mastery, Choosing Titles, Prefix Tutor. The titles alone tell us we don't need this nonsense. There's no wit here. No whimsy. Just whistling in the pedagogical dark.

I am stunned by the wrongness. These products are billed as research based and dazzling up-to-date, but they give me a prickly feeling of deja voodoo, proving over and over that anything that can be put in a dime-store workbook can also go on a floppy disk. I recall Dorothy Parker's advice about a book she was reviewing: "This is not a novel to be tossed aside lightly. It should be thrown with great force. Likewise, I recommend rubbing these skill disks with a nice big magnet.

Or how about the program that asks students to reconsruct on a blank screen a passage from Magic Mountain by Thomas Mann? If that task seems rather strenuous, the student can choose instead to supply every other letter or all the vowels. I'll admit there is an interesting principle at work here, one involving "structural clues," but I cannot fathom the choice of literary selections. Nor can I believe that a student, assuming she does re-create the passage, would ever be inspired to read the real thing. (But I confess to never having finished Magic Mountain even when all the letters were there right from the start.) When I see such an excerpt in a program purportedly designed for students age nine and up, I wonder who is kidding whom.

Tremendous effort seems to have gone into producing software that spews out readability formulas for any literary passage you care to input. In my survey, I discovered programs based on most of the major word- and syllable-counting schemes, including Flesch, Lore and Fry, Dale-Chall, the Navy, General Motors, Bell Laboratories, the Department of Defense. But such software only encourages teachers to dump the delicate art of guiding students to books best able to capture their interests and imaginations in favor of academic numerology. And I say to hell with it.

I also uncovered numerous computer versions of word scramble, hangman, Go fish and Old maid. Certainly kids like such stuff, but I can't see that the computer enhances these old chestnuts. I'd rather see a child playing Go Fish with a friend than a machine. I'm not even convinced that kids would choose to play hangman on the computer rather than on the chalkboard-not wihout some moments of deliberation. (Kids love the word-processing capabilities of chalk and eraser.) But if a teacher is determined to find some use for the electronic beastie in her reading classroom, better she let the kid play hangman than insist he search-and-destroy all the cr blends he spots or shoot down vocabuary words. And for teachers who laboriously construct crossword puzzles and word searchers, the good news is that programs exist to simplify their lives.

A GLIMMER OF HOPE AMID ALL THE BRIGHT LIGHTS

If we do not set our expectations too high, then there are some software programs that can be useful in the classroom, programs worthy of some celebration. I've looked at various programs traveling under the name of poetry that are fun and even intriguing the first few times one plugs in words. But I hope that teachers will help children to see that poetry is the careful, meaningful choice of words, that writers work hard at their craft, that even though plugging in words at random can be fun, it isn't poetry. A program such as Suspect Sentences (Ginn), in which a student tries to hide an original sentence in a literary passage so that his peers can't find it, seems to have more potential than most language arts programs. To play this game successully, students must read critically and then model their own writing after an author's style. They certainly won't come away thinking that any old word will do.

The Sentence Maker portion of Word Worx (Reston) encourages children to use their understanding of grammatical structure to create sentences. The computer presents five letters, and players try to make sentences using those letters. Once a word is used, the computer will not allow it to be used again. Kids keep making sentences until they run out of ideas or guess the computer's sentence (an adage or famous quote). Although critics might point out that such an exercise addresses only surface and not deep grammar, it is nonetheless one of the better programs available, and teachers need not feel apologetic for allowing it into a classroom.

NEVER FORGET THE PAGEANTRY OF PEAS

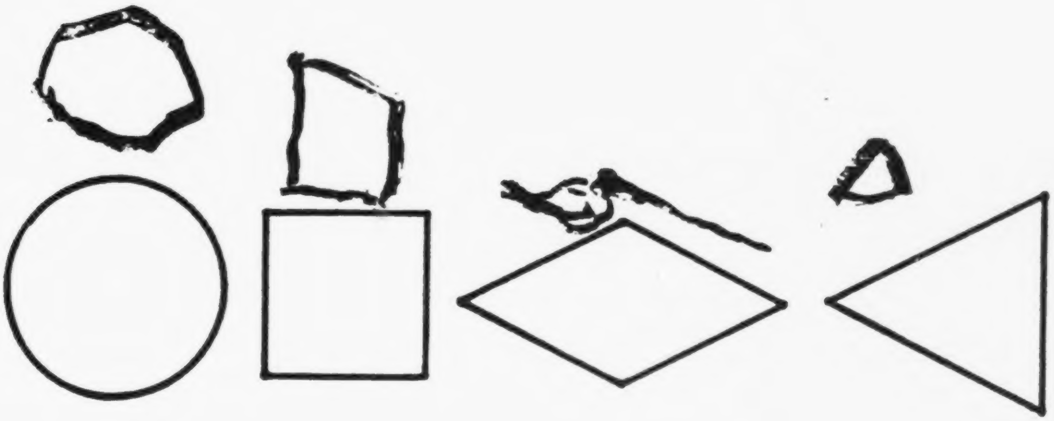
When all is said and done, the computer is not going to stimulate much reading. Reading a screen filled with type is neither amusing nor inspiring. It is actually painful, and people who are forced to do it should receive adequate monetary compensation. Certainly it is not something we should inflict on children we are trying to encourage as readers.

Long ago, E. B. White commented on the great technological breakthrough that promised to revamp the kitchen so that we could push a button and peas would appear on a paper plate. White pointed out that the technocrats had misunderstood the "pageantry of peas." Similarly, though I am bombarded by an electronic hailstorm, I'm not willing to let the skills people get away with obscuring the pageantry of reading with their flood of state-of-the-art sound-and-light shows. I don't care if the kids down the hall stay a skill lesson or two (or even 56) ahead forever.

No. Instead, I hope to nurture my students in an environment that convinces them they might want to read a book someday. I see too many proficient decoders, kids who perform extremely well on standardized tests but never willingly pick up a book. They have mastered an incomplete system, one they find lacking in marvel or mystery. As Mark Twain reminds us, the man who doesn't read good books has no advantage over the man who can't read them.

So I say to those fellows with their whistling curriculum: I am wary of mistaking convenience for progress. The worth of a machine depends upon the use to which it is put. Marching children through reading systems in the name of efficient record keeping has the pedagogical justification of a No-Pest Strip. One good book is worth 1,000 floppy disks. Or more I'd trade my WordStar disk for almost any one of E. B. White's sentences. Or Gore Vidal's. Or Calvin Trillin's. Or Max Apple's. My list is wonderfully long. And I would no trade my memory of Jessica's face when whe first read Amelia Bedelia for a whole skills-management system.

Even such a rationalist as George Bernard Shaw confessed to a fascination with machines, saying he once nearly bought a cash register "without having the slightest use for it." We teachers are probably more vulnerable to things mechanical than most. We live harried, hassled lives, beset by hucksters and inspectors alike. But we must keep track of what matters, what the children need. We must not allow bored, restless managers or sharpshooting wheelerdealers who are ever reaching for some pie-in-the-sky to turn our reading programs into technoskill dumps, wastelands harzardous to the well-being of the children. Do not go gentle into that computer lab. Question. Judge. And, if necessary, rage. And always, always: Resist much.



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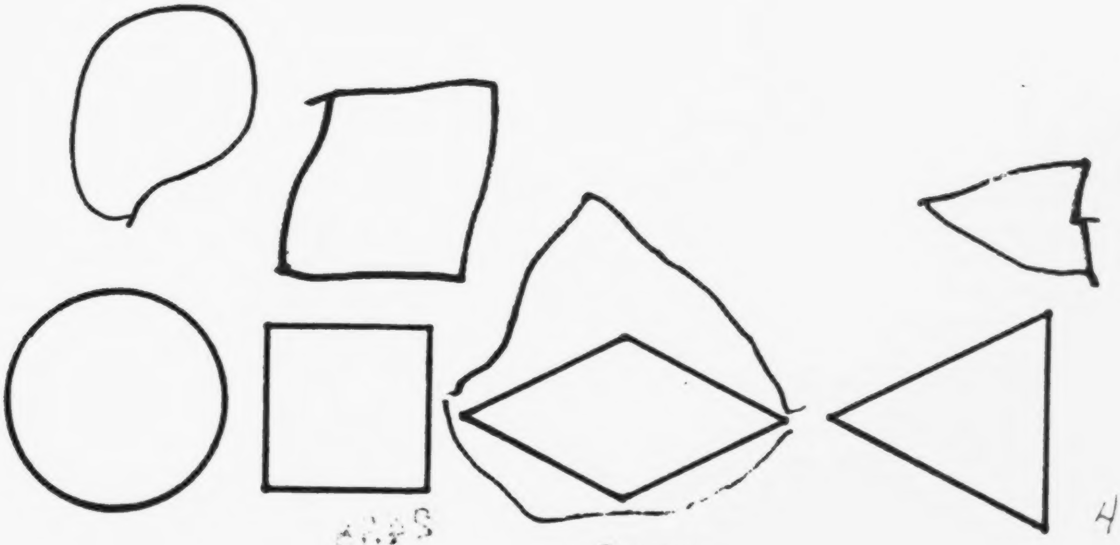

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Gifted?

Karen Riess

The longer I teach, the more interested I become in the manner in which educators label students as "gifted", "merely average", "slow", and all of the other classifications which we so eagerly place on students. What special abilites do students need to be placed in the "gifted" category? Are they active thinkers and problem solvers or are they good at taking SRA tests, at playing political classroom games (it's a shame they must do this at such a young age), at memorizing, at being "good" kids. I'm leaning increasingly to the idea that many "gifted" students are weak at problem solving and thinking skills, have relied solely on memory, and are reluctant to tackle new concepts on their own. They want to be spoon fed facts and are easily frustrated if they aren't quickly given solutions.

During a child-watching activity, I told a class of sixth grade students that I would choose a number from 1 to 100. Each of them would have an opportunity to guess the number. I would tell if each guess was too high or too low and we would continue until the correct number was guessed. Each student was taken into the hall individually, so that no other student could pick up any strategies. In reality, I had no specific number in mind, but instead would say "higher" or "lower" in whichever direction there were more numbers. For example, if a student's first guess was 25, I would say higher. (There are 75 numbers higher to guess from and only 24 lower.) This method was used to get the most guesses from every game. Student's guesses are followed by my response.

Student A

50	higher
75	higher
80	higher
90	higher
100	lower
95	higher
96	higher
97	higher
98	higher
99	That's the number

This student has straight "A's" and is part of our gifted program. (The "gifted" students are those who have scored above the 90th percentile on the SRA tests and are recognized by their teachers as being outstanding students.) She strives to get the best grades in her class, but is reluctant to share any of her knowledge with her peers and would rather work alone than with a group. She has the ability to think logically, and usually does so at first, but she gets easily rattled if she can't immediately discern the correct answer. This trait can be observed in her guesses. She starts out by splitting the range of numbers in half, but then goes on to a more random pattern.

This girl is also in the gifted program. Many teachers consider her to be the top

Student B

60	lower
50	lower
30	lower
29	lower
9	higher
15	higher
23	lower
18	higher
20	higher
21	higher
22	That's the number

sixth grade student, although this opinion is often accompanied by comments like "She's so sweet and well-behaved." Personally, I'm not sure if she has ever thought out a problem in her life. She as an excellent memory and can easily regurgitate facts, but does not produce "new" ideas of her own. Her answers in the game are random, with no apparent pattern.

Student C

50	lower
25	lower
15	lower
8	lower
4	higher
6	higher
7	That's it

This student is in the gifted program, but several teachers would like to have her removed because of her grades. She does well at thinking-type problems but is often careless with basic facts. She readily admits that "facts bore me" and is quite content with the B's and C's that she often gets for grades. Her answers were planned and she arrives at the number with a minimum number of guesses.

Student D

50	lower
25	higher
40	lower
30	higher
35	higher
37	higher
38	higher
39	That's it

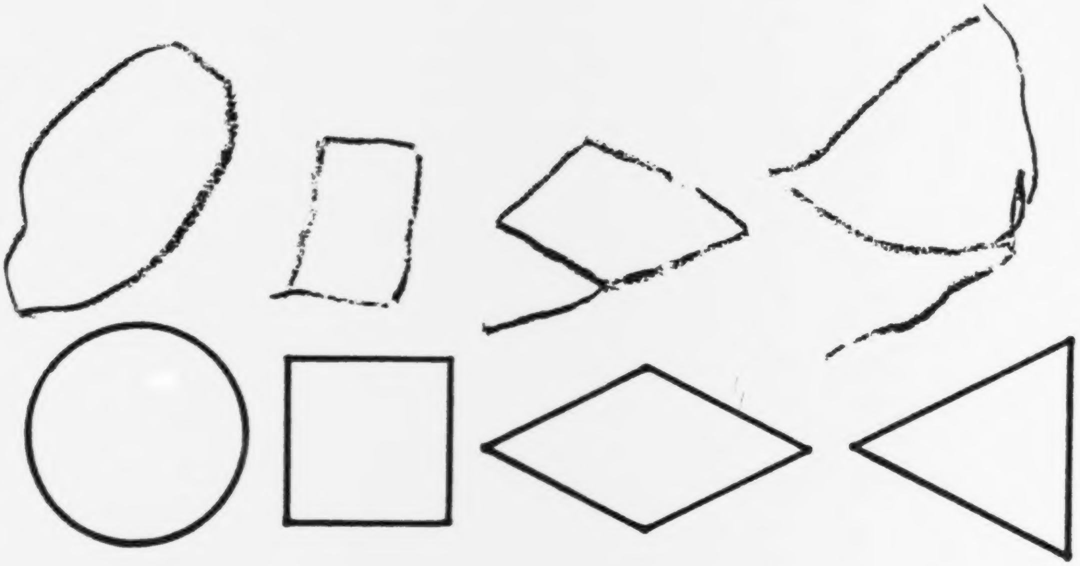
This student is classified as "average" by many teachers. He is not great at memorization, but can eventually think through his solutions. It is interesting to note that he wanted to play the game again because he wasn't sure if he had "always picked the exact middle number". He obviously had a plan to what he was guessing.

Student E

50	higher
75	higher
85	higher
95	lower
90	higher
93	lower
91	higher
92	That's it

This student also has a difficult time in maintaining even a "C average" and does not do well on basic fact type tests. He does do extremely well, however, on assignments which require logical thought as opposed to memorization.

I would like to note that when students got together and started commenting about the game and comparing how many guesses it took, Students D and E started wondering if the game had been "fixed". They reasoned that someone should have only taken one or two guesses if everything was really legitimate. This line of thought led them to investigate the least number of guesses it should ever take and decided the answer was either seven or eight. Students A and B refused to get involved in the discussion, stating that such trivial games were wasting their time, and that "certain teachers they knew" would be better off teaching rather than playing childish games with absolutely no point whatsoever.



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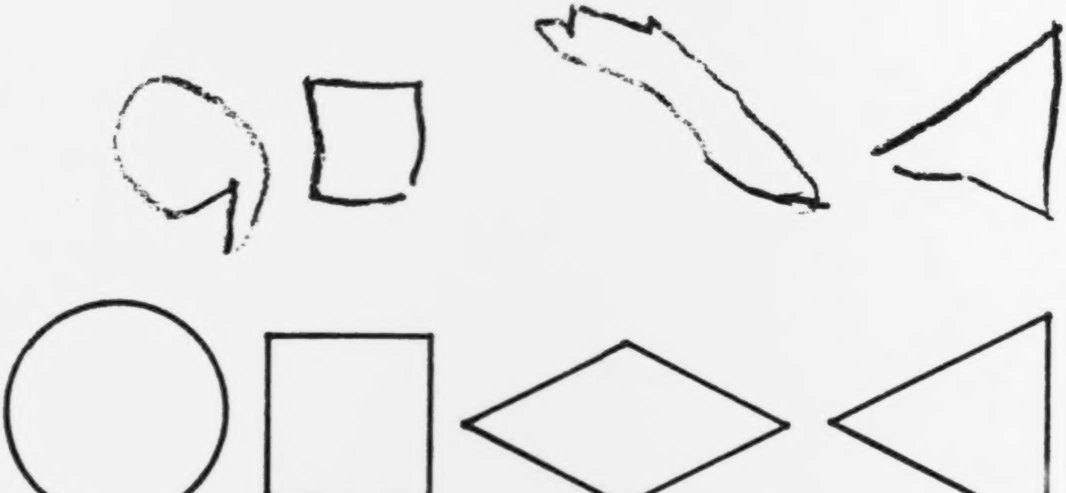

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CHOOSING TWO BEADS

Virginia Small

This problem solving activity was taken from a Teachers' Center book by Tamas Varga. Dr. Thomas O'Brien said, "in Varga: On Probability, it's fair to say, you see big ideas made simple (or are big ideas usually simple to begin with?) so that the world, especially children, might regard them as commonplace." This is the first time I've tried a probability activity in my first grade classroom. To do this activity you need five beads: two of one color, three of another. These beads should be placed in a small box. If you choose two beads without looking, you will come up with two of one color or one of each. (two red, two blue or one red and one blue) The question is, "Which of the three possibilities is most likely, least likely, in between?

I had the children try to predict or guess which beads will be chosen. We made a chart on the board to record our guesses. First we guessed what we thought a student would choose and recorded our guesses. A student then came up and chose two beads, and we recorded the actual selection and calculated the difference. How good were our predictions? Some were pretty good and some weren't. We didn't comment on the quality of the predictions. We concluded that sometimes things don't come out as we expect.

The children find this interesting and pair off to do it on their own. This is quite a rich activity to try with your classroom.

	PREDICTIONS	OUTCOME	DIFFERENCES
2R			
3B			
R3			

CHILDCARE CHECKLIST

Barbara Goldenhersh

As a preschool teacher, I am quite concerned with our present need for more child care facilities and the corresponding need of parents for guidlines in selecting quality day care, especially in this time of negative publicity. The following checklist is a reaction to that need.

This checklist is a parent guidline generally applicable to part and full time child care facilities in both school and home care settings. The areas covered should also make child care centers be aware of the multiple needs of their children and structure their programs and facilities accordingly.

FOR ALL CHILDREN

Does the center...

* Maintain an open door policy?
* Encourage visitors to stop in?
* Allow parent or guardian to drop by to observe?

Does your child's caregiver...

* Appear to be warm, calm and friendly?
* Seem to have a sense of humor?
* Seem to be someone with whom you can develop a relaxed, sharing relationship?
* Seem to be someone your child will enjoy being with?
* Seem to feel good about themselves and their job?
* Have child rearing methods that are similar to your own?
* Treat each child as a special person?
* Understand what children can and want to do at different stages of growth?
* Have the right materials and equipment on hand to help them learn to grow mentally and physically?
* Patiently help children solve their problems?
* Provide activities that encourage children to think things through?
* Encourage good health habits, such as washing hands before eating and after using the bathroom?
* Talk to the children and encourage them to express themselves through words and language?
* Have art and music supplies suited to the ages of all children in care?

- Encourage children to express themselves in creative ways?
- Seem to have enough time to look after each of the children in their care?
- Help your child to know, accept and feel good about himself or herself?
- Help your child learn to get along with and to respect other people?
- Provide a routine and rules that the children can understand and follow?
- Take time to discuss your child with you regularly?
- Have previous experience or training in working with children?

Does the day care center have...

- An up-to-date license, if one is required?
- A clean and comfortable look?
- Enough space indoors and out so all the children can move freely and safely?
- Enough caregivers to give attention to all of the children?
- Enough furniture, play things and other equipment for all the children?
- Equipment that is appropriate, safe and in good repair?
- Enough heat, light and ventilation?
- Nutritious meals and snacks that meet your preferences about the types of food you want your child to eat?
- Enough room and cots so children can take naps? (if applicable)
- Enough clean bathrooms?
- Safety caps on electrical outlets?
- Smoke detectors and fire extinguisher?
- Covered radiators and heaters?
- Strong screens or bars on windows above the first floor?
- A separate place to care for sick children where they can be watched?
- Dangerous items out of the reach of children?

Are there opportunities...

- To play quietly and/or actively, indoors and out?
- To play alone at times and with friends at other times?
- To follow a schedule that meets young children's needs for routine but is flexible enough to meet different needs of each child?

- To use materials and equipment that help children learn new physical skills, develop muscular control and get exercise?
- To learn to get along, to share and to respect themselves and others?

For Preschoolers

Does your child's caregiver...

- Plan different activities for the children?
- Join in the activities with them?
- Set consistant limits which help the children gradually learn to make their own choices?
- Recognize the value of play and encourage children to be creative and use their imagination?
- Help children feel good about themselves by being attentive, patient, positive, warm and uncritical?
- Allow children to do things for themselves because she or he understands that they can learn from their mistakes?
- Read to the children and help them learn the language by talking with them and answering their questions?

Are there opportunities...

- To play with many different toys and equipment that enable preschoolers to use their imagination?
- To choose their own activities for at least part of the day?
- To visit nearby places of interest?

Specific remarks addressing avoidance of child abuse.

As a child care parent, be sure you are welcome without an appointment at the child care facility. On such visits you should see children playing happily with others as well as relating comfortably with teachers. Your coming in should have little effect on the children and few will gather around you if the children have feelings of security from their caregiver.

Listen carefully to your childs responses to school, remembering that little things happen that may upset a child in any setting. It is the fear, nightmares, and/or major changes in your child that must be given immediate attention.

AN ESSAY ABOUT EGOCENTRISM

C. Jananne Threlkeld

Several years ago I became interested in exploring my own personality, and, at that point, I discovered that what I consider to be my own personality began during my high school years. I cannot remember "me" before that time other than in isolated incidents, and since that time.my history has continuity for myself. Other adults have expressed that same sort of historical relationship with their own personalities. As I have read about Piaget's work with adolescent thinking, the development of formal operations, and the egocentrism distinct to adolescents, I see a relationship between the development of the final stage of mental operations and the emergence of personhood.

Jean Piaget used the term "egocentrism" to refer to a lack of differentiation in some area of subject-object interaction within any of the stages of development. The particular characteristics which egocentrism takes differ from one developmental stage to another. The characteristics of egocentrism in middle childhood and adolescence are of special interest to me as a secondary education teacher. Elkind says that egocentrism might be the bridge between cognitive structure and personality dynamics. The middle childhood examples of egocentrism in the forms of assumptive realities and cognitive conceit are both recognizable in junior high-age youngsters as the imaginary audience and the personal fable of adolescents are recognizable in the high school population. Inhelder and Piaget say that egocentrism is one of the most enduring features of adolescence which persists until adult work begins.

Many junior high age students are said to be in the concrete operational period of development. At this stage children fail to distinguish between hypotheses and assumptions and empirical evidence. A child operating according to an assumptive reality based on limited information is not likely to change his/her point of view on the basis of new and contadictory evidence. The discovery that parents are wrong about some things leads this age child to believe that parents are wrong about everything. By the same measure, the child assumes that he/she is right about some things and is, therefore, right about all things. This conclusion leads the child to the complementary assumptive reality termed "cognitive conceit." This assumptive reality assumes that adults are not bright and that children are clever and the equals of adults. Many juvenile jokes are based in this assumption as well as the Peter Pan fantasy or the wish to remain a child. Also included as an assumptive reality is the fondling fantasy or the belief that the child has been adopted and is really of royal parentage or at least wealthy parentage. In addition an "external conscience" is operative for this age child which makes the rules and reasons for obeying them not a part of the child but imposed by adults. At the end of childhood and beginning of adolescence, the true conscience begins and is demonstrated by rigid group morals. Assumptive realities do not necessarily disappear in the next stages of development. A common example of this belief is the romantic notion of love and marriage is held by many young girls despite contrary evidence.

Adolescent egocentrism is related to the major task of early adolescence, the conquest of thought. With formal operations the adolescent is able to understand the thoughts of others; however, adolescent egocentrism does not allow him/her to differentiate between his/her focus of thought and that of others. The adolescent, therefore, believes that everyone is as concerned with his/her appearance and behavior as he/she is. The adolescent anticipates reactions of others to his/her own behavior either in admiration or with criticism. The adolescent believes he/she is the focus of attention and is reacting to "an imaginary audience." Adolescent self-consciousness and need for privacy may be based on the imaginary audience.

The complementary mental construction to the imaginary audience is the "personal fable." This construction is an untrue story the adolescent tells him/herself; it is a belief in personal uniqueness and immortality. Adolescent diaries are good sources for personal fables of God as a personal confidant or of young girls who believe they will not become pregnant.

The imaginary audience becomes the real audience through modifications as the adolescent tests against reality and begins to recognize the interests of others. The personal fable is diminished by the establishment of intimacy with the feelings of others. The idealism of adolescence is eventually replaced with reality as the adolescent assumes an adult role.

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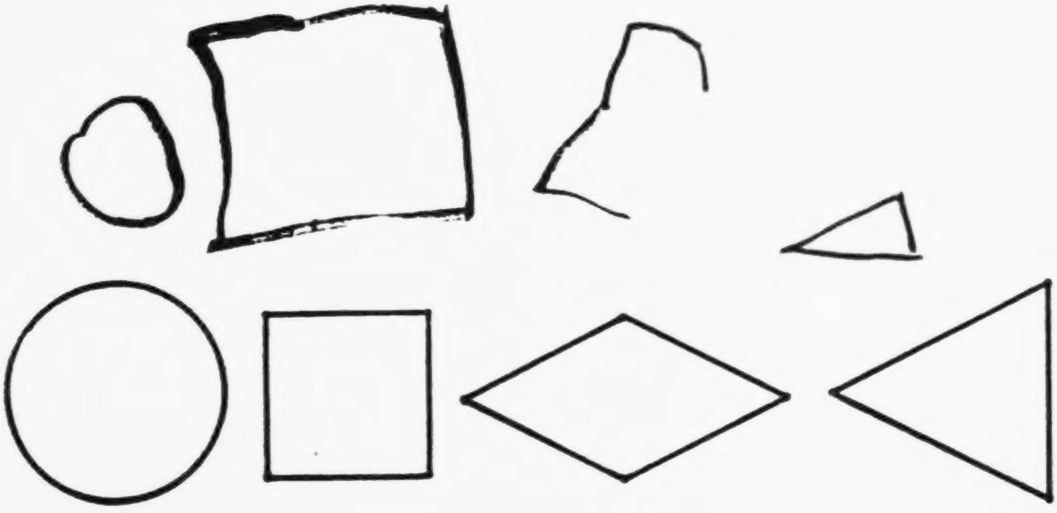

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MICROCOMPUTERS ALTERING THE CURRICULUM

Beverly Arnoldi

It all started with an explosion. The explosive advent of the microcomputer came in the late 1970's. The reduced cost, portability, reliability, and "friendliness" of micro-computer systems have filtered them into all aspects of our society, including the home and school. "Micro-computers have made a dramatic impact on both the potential and the reality of educational uses of computers."[1]

The micro-computer, however, is only a piece of equipment. "Microcomputers on their own will not promote any particular outcomes. Their impact will depend to some extent on hardware and software development. To a much larger extent, however, the effects of microcomputers on educational practice will depend on the social and educational contexts within which they are embedded."[2]

The individual teacher will play a major role in advocating and developing the use of the computer in the schools. Teachers will need to know how to technically use and possibly program machines, to evaluate the various hardware and software, when and where to use the computers effectively, and to develop new curriculums to use with the computer.

The problem facing many schools is that "most teachers in today's public schools have not had any training or background in computer or technological literacy, usage, or adaptation."[3]

The training should encompass the ideas that:

1. Technological literacy is non-course specific. Teachers of all subjects must assume responsibilites.
2. Training emphasis must be on curriculum development rather than on programing development.
3. Criteria for evaluating software and hardware has to be on going.
4. Content application, by grade and subject level, must be infused or imbedded within instructional objectives for particular disciplines.

While bringing the microcomputer into a working curriculum, "We must attend to what happens when children and computers mix. Teachers can learn more about these machines, and even more about learning - children's and their own - from planned observation in the classroom."[4] In this way teachers may begin to develop their judgement about when and how to use computers in their classrooms. They must also observe which software is the most valuable, and the software that produces higher level thinking skills.

In much of the curriculum today, educators lean heavily on the transmission of "static" knowledge. Information and facts are given by the teacher to be stored in the memory of the students. The classroom is teacher centered, with all knowledge evolving from the teacher. (With the aid of textbooks, workbooks, etc.)

The use of the computer for strictly drill and practice or tutorials is a mirror image of the same traditional style of teaching static knowledge.

"The goal of education should be to cause intellectual growth, not merely to teach children the facts, rules, procedures, conventions, and nomenclature of narrow knowledge."5

To achieve this goal, "dynamic" knowledge needs to be worked into the curriculum. "Dynamic knowledge is the construction of relationships, the coordination of information, and in general, the organizing of one's internal road-map of reality. It is this knowledge that generates new knowledge."6

The teacher needs to give children the initiative, enabling the child to take control and be the "teacher" of the computer, to be able to test out their own theories and ideas without the fear of being wrong. This could be a powerful tool in facilitating learning.

Computers may be used in the curriculm to:

1. Help students learn to write.
2. Process data to solve a problem.
3. Provide educational experiences not possible without a computer. (e.g., Logo, Koala Pad, etc.)
4. Develop higher level thinking skills.

"Microcomputers make it possible for teachers to enrich their curriculum with thought-provoking activities. Moreover, computers can randomly -and patiently- generate an endless variety of problems and give students nonjudgemental, private feedback that lets them learn at their own pace."7 This frees the teacher to work with individual students and small groups.

American education needs to go "forward to basics- to thinking, to imagining, to inferring, to discerning relevent from irrelevant, to classifying and ordering, to generating and testing and cancelling alternatives, to solving problems and inventing new ones."8

The implementing of the microcomputer into our schools, places this type of achievement in education a dream that is within reach.

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BOOK REVIEW: MEGATRENDS-JOHN NAISBITT

Sara Sally Biarkis

As the title implies, Megatrends describes general directions that American society is taking today. The premise of the book is "To anticipate the future by understanding the present." To accomplish this premise, Mr. Naisbitt has identified and discussed ten issues that he feels will transform the social, economic, political and technological aspects of American society.

1. moving from an industrial society to an information society;
2. matching technology to human response and human needs;
3. going to a world economy rather than a national economy;
4. moving toward long-range planning rather than short-range thinking;
5. going to decentralization (bottom/up) from centralization (top/bottom);
6. moving from institutional dependence;
7. having participation, not representation, in our society;
8. changing from heirarchical structures to networking and clustering;
9. population shifts from the North/Northeast to the South/Southwest; and
10. moving from either/or solutions to multiple options.

Naisbitt does not consider himself a futurist. He forecasts trends by counting and analyzing news items that have appeared in daily newspapers across the nation. He then discussed these trends with people across the country. Even though this research method does have its limitations, the results are thought provoking.

Each of the ten directions are food for thought. Two examples are: People are moving to the West and South. This is causing a shift in the leadership and creativity for our country. We are looking toward the West and South for new leadership. The "trends" are being set in California, Washington State, Colorado and Florida rather than in New York, Connecticut and Washington, D.C.

Our attitudes as people are changing. We are not as "specialized" as we have been in the past. We are taking responsibility for our health, our emotional and physical needs. We, as a nation, are learning to take care of ourselves. We are losing our fear of computers and other technological advancements. We are learning how to use them to help ourselves.

Educational attitudes need to be changed to help the children of our country learn to live in this "new society" that is developing before our eyes.

Mr. Naisbitt does offer us a context to sort out and assess the rapidly changing world we are living in. He gives the reader a chance to look, examine and understand the changes that are taking place in America today.

TEACH THE NEGLECTED RIGHT BRAIN

Joyce Bishop

In the 1960's Roger Sperry and his co-workers were able to study a group of former epileptics who had been successfully treated by cutting the corpus callosum, the fiber tract which transfers nerve impulses between the right and left hemispheres of the brain. Known as the split-brain patients, these subjects provided researchers with a new way to compare the different modes in which the two sides of the brain function.

In one type of test, researchers flashed a different image to each side of the brain. When asked to draw what he had seen, the patient drew what the right brain had seen. When asked to name what he had seen, he named what the left brain had seen. These results and others convinced investigators that the two hemispheres of the brain operate independently of each other.

Scientists are still debating the implications of these findings and other more recent research, but a few generalizations about brain function prevail. It appears that the left side of the brain is more rational, sequential and analytic, whereas the right side is intuitive, synthetic or holistic. The left side appears mainly responsible for language, while the right side is concerned with spatial relationships.

Elkhonon Goldberg of the Albert Einstein College of Medicine and Louis Costa of the University of Victoria see the right hemisphere as a "jack-of-all-trades, a generalist that addresses new problems without preconceptions, and tries many solutions until it hits on one that works. The left hemisphere, in contrast, is a specialist, solving familiar problems quickly and efficiently by using established methods."[1]

Anatomical differences in the two sides of the brain may help explain the variation in function. The right hemisphere contains many long fibers which connect widely separated regions of the brain, each specialized for different types of information processing. The left hemisphere is composed of shorter fibers with many connections in a more compact region. This permits detailed processing of more well-defined tasks.[2]

How do these findings relate to the typical classroom? In 1975 Roger Sperry wrote "our educational system and modern society generally (with its very heavy emphasis on communication and on early training in the three Rs) discriminates against one whole half of the brain. I refer, of course to the nonverbal, non-mathematical minor hemisphere, which we find, has its own perceptual, mechanical, and spatial mode of apprehension and reasoning. In our present school system, the attention given to the minor hemisphere of the brain is minimal compared with the training lavished on the left, or major hemisphere."[3]

The current trend toward minimum competency testing has accentuated the inequities, with all areas of learning broken down into small units of information more readily tested, and less attention than ever given to trends, generalizations, and the overall view of a subject.

Why do we need to worry about this other half of the brain? It is the center of a nonverbal "spatial" thinking which does not reduce a problem to a verbal description but allows the thinker to assemble and manipulate ideas in his mind.[4] Albert Einstein remarked that his ability lay in "visualizing effects, consequences, and possibilities" by means of "more or less clear images which can be voluntarily reproduced and combined." James Watson of the Nobel Prize-winning genetics team and James Maxwell who devised the electro-magnetic equations each credit a breakthrough to a vision, a mental picture of something heretofore unknown.[5]

These right brain thinking patterns are apparently in demand in the business world as well. A recent article discusses attempts to go beyond IQ tests to predict achievement in careers. Studies of successful executives and competent managers point to such characteristics as the ability to plan without being locked into one course of events, the capacity to acquire ample information for decision making without being over-whelmed, being able to grasp relationships between rapidly changing events, being able to spot hidden patterns in an array of facts, and a tendency to plan long into the future taking into account all possible events that can be anticipated, as well as the consequences of these events.[6]

These characteristics are not the only indicators of business success, but they do illustrate thinking skills not normally emphasized in the classroom.

What can the classroom teacher do to promote right brain development? Many teachers are already pursuing right brain activities. The preschool teacher or parent who refrains from calling a tree a tree and instead encouraged a child to touch it, smell it, listen to the wind in the branches, compare the shapes of different leaves, plant its seeds and explore the complexity that is a tree helps a child go beyond a limiting left-brain label. So does the teacher of graduate students who presents a problem, passes out the manipulatives and quietly fades into the background to allow students time to explore and experiment.

Children need uninterrupted blocks of time with no one talk, talk, talking at them to allow them to shift to the right hemisphere mode. Manipulatives encourage them to explore the spatial relationships of a problem.

Music, drawing and painting all encourage shifts to the right mode. Drawing exercises in which an up-side-down drawing in copied or in which one concentrates on the negative space around an object force the artist to shift from a name-the-familiar-object behavior to a look-at-the-shape-of-the-space behavior which is typical of the right hemisphere.[7]

The familiar creativity-inspiring activites such as asking yourself what might happen if we suddenly had three arms or how many uses can you think of for a rubber ball stimulate fluency of ideas, flexibility and the ability to redefine.[8]

The right brain thrives on complexity, so avoid over-simplifying. Use the chalkboard for pictures, diagrams, illustrations and patterns. Try to present as much information as possible both verbally and visually.

Experiment with conditions that encourage shift from one mode to the other. Read a passage for facts and ask for verbal or written responses. Then read for meaning or content and ask for response in the form of a poem, painting, dance, riddle, pun, fable or song. Distinguish between math problems which require linear, logical thought, and those which require imaginary rotations of forms in space or manipulations best accomplished by visualizing patterns.[9]

Research into the different functions of the left and right hemispheres of the brain presents as many questions as it does answers. However, it does provide some insight into those unique problem-solving abilities which are seemingly available to some people and not to others. With our nation, and indeed our world, facing problems of unthinkable magnitude, now is the time to use every available method to develop the full mental potential of a new generation of thinkers. Who knows in which young heads lay the keys to brilliant solutions?

FOOTNOTES

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ADVANTAGES OF DELAYED KINDERGARTEN ENTRANCE FOR "LATE BIRTHDAYS"

Barbara Goldenhersh

Maturity, a relative factor sometimes difficult to evaluate, is not directly related to chronological age but hass a close relationship to it. Perhaps the value of your child having the "maturity edge" can best be explained by the following:

The mature child will:

1. Be a self starter. He will take responsibility for his own education. Parents will not have to ask this child, "Have you done your homework?" or have to listen to the teacher say at conference time, "Your child has the ability to do better work, but he's just not putting out his best effort."

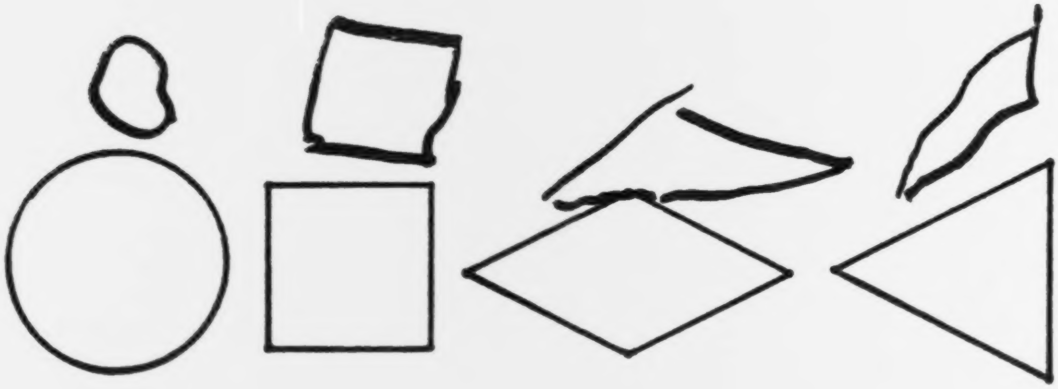
2. Be able to communicate her needs and feelings to teachers and classmates. She will not be afraid to ask a question when she doesn't understand the subject matter or the assignment. She will not feel that she has to join in when a classmate suggests doing something that she thinks is silly or unsafe. Problems and unresolved conflicts will not build up inside because she is unable to communicate them.

3. Be better able to cope with the problems, pressures, and complexities of school, the substitute teacher, the day the teacher feels rotten, the unfair teacher who over disciplines or punishes everyone for one child's mistake, unkind classmates, days when everything goes wrong, etc. In a similar way, the child with the maturity edge will be in a better position to cope with personal set-backs such as illness or a family move.

4. Have many positive feelings about himself which will constantly be reinforced as he compares himself with his classmates socially, emotionally, physically, and acedemically. These positive feelings will continue to build as the child's personal expectations for himself are met and as he and his parents compare his performance with that of his siblings.

5. Have the ability to get the most out of school. She will be "on top of things." She will not feel pressured. She will feel relaxed and in control, able to do the extra things that make school fun--such as athletics, music, and dramatics--without having her school work suffer.

We need to take a long look ahead as we consider the important decision of delayed kindergarten entrance. If there is ever to be a time for "more time" it should be now. As parents, ask yourselves if more time for a broader and stronger foundation of "self" will be benificial for your child. Ask yourself if time for horizontal enrichment and needed developmental growth will insure that your child will be ready for the opportunities and demands of grade school, high school, college or graduate school if he wishes, and a life-long interest in learning and using his or her potential to the fullest.



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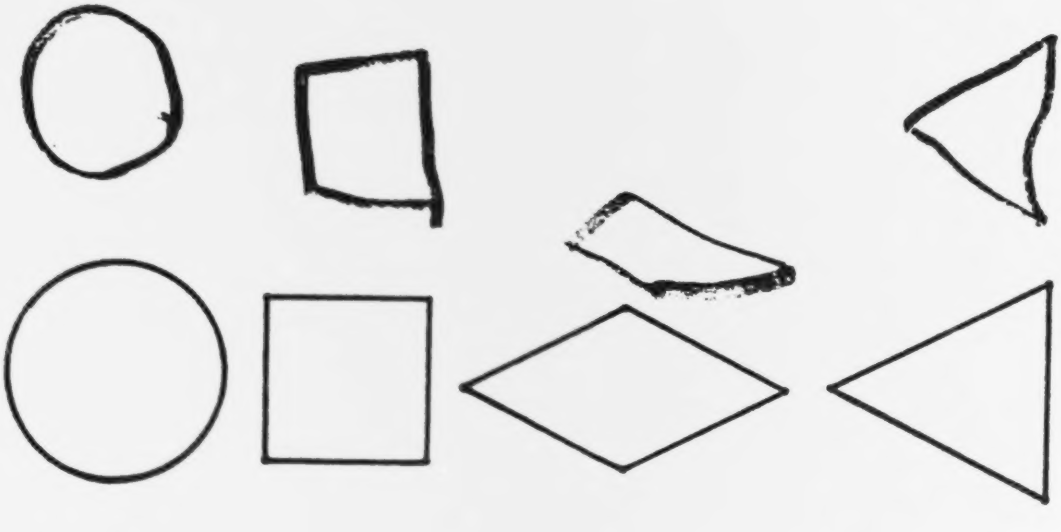

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Virtues of Reading Aloud Regularly to Children

Fred M. Hechinger

(The following article appeared in The New York Times November 12, 1984. Reprinted by permission. Copyright, The New York Times 1984.)

"Reading to your children may be the single most powerful contribution that you, as a parent, can make toward their success in school," William F. Russell says.

The one common factor in all chidren who learned to read easily, he says, is not a high I.Q., not family income, not parents with college degrees. Rather, it is that those children who had been read to regularly by their parents from whatever materials happened to be at hand - newspapers, road signs, even product labels.

Still, Dr. Russell, who holds a doctorate in education, prefers good literature, and he offers parents a choice in his new book, "Classics to Read Aloud to Your Children" (Crown Publishers, $13.95).

Reading aloud to children may be turning into a national movement. Two years ago, Jim Trelease, a newspaper reporter, artist and father, published "The Read-Aloud Handbook" (Penguin Books, $6.95). In an interview he said parents should begin by reading to their 6-month-old infants. By age 2, he added, being read to ought to be a daily activity, preferably before naptime and before going to sleep in the evening.

The prescriptions of Dr. Russell and Mr. Trelease overlap. Mr. Trelease urged that reading aloud be continued in school, from the first day, and at least through elementary school. Dr. Russell agrees but suggests extending the practice into early adolescence. He says it is a mistake for parents to stop reading aloud to their children as soon as they learn to read by themselves.

The complexity and vocabulary of a book that may scare an eighth-grader away may be readily understood when the child hears the work read aloud, Dr. Russell says. Children's first-grade primers, he points out, are written with a controlled vocabulary of only about 350 words, even though most first-graders actually have a "listening vocabulary" of almost 10,000 words. In other words, not reading real literature to them is an insult to their intelligence and dulls their appetite for books. Occasionally, Dr. Russell admits, he was tempted by difficult passages to simplify the original text, but as soon as he imagined the authors "leering" over his shoulder he left things intact.

Apart from intellectual benefits, much affection can be generated during family reading sessions, bringing children and parents together more effectively than merely watching television might.

In his selected classics, Dr. Russell begins his Level 1, ages 5 to 8, with Hans Christian Andersen's "The Ugly Duckling," and concludes with "The Golden Touch," adapted from "The Wonder Book" by Nathaniel Hawthorne. Level 2, ages 8 to 11, begins wih a selection from Mark Twain and includes an O. Henry story and parts of Romeo and Juliet. Level 3 starts with an excerpt from Stephen Crane's "The Red Badge of Courage" and moves to a selection of poems. Finally, he includes "holiday favorites" from Easter and Passover to "A Christmas Carol." But in an interview Dr. Russell stressed that the book intends to show parents how to select their own candidates for reading aloud.

Mr. Trelease's book included a guide to more that 300 read-aloud suggestions. The search for materials may lead others to the Seedling Series, paperbacks published quarterly for children by Short Story International. It contains the unabridged works of contemporary writers from all over the world and is available by subscription (P.O. Box 405, Great neck, N.Y. 11022; four issues for $12.) The series, which is in its fourth year and is aimed at ages 9 to 12, features stories by American and foreign writers.

"We have discovered," said Sam Tankel, the publisher, "that children are fascinated by stories about children, particularly from other countries."

Since children usually want their favorite stories read over and over again, Dr. Russell urges parents to pick reading that interest them as well. When the adult reader appears uninspired, the message, he warns, is that reading is boring.

Fathers should be as much involved as others, Dr. Russell says. Single parents should recruit adult readers of the opposite sex - grandparents, neighbors, friends. The male role, Dr. Russell stresses, is important because children often see reading as a feminine activity: most elementary school teachers are women. The male-female issue is especially important for poetry, which is often mistakenly viewed as not a "manly" pursuit.

Dr. Russell prefaces each selection with the approximate reading time. He considers it vital that reading sesions not be cut off in midstream because time has run out.

Reading aloud to children is making converts. In Chicago, Mayor Harold Washington plans to begin a media campaign early next year and to distribute information to public schools, libraries, churches and youth organizations and parents.

In Delaware, State Representative Kevin W. Free organized a statewide project in pediatric clinics. As part of the project, trained volunteers talk to parents in waiting rooms about the need to read to their children. The program also trains teen-agers to read aloud to their younger brothers and sisters.

In New York, the United Federation of Teachers supports Parents as Reading Partners, a program that encourages parents and children to read together at least 15 minutes a day.

In an afterword, Dr. Russell cautions: "Don't think that a book must be either one to read aloud or one of your children's own silent reading. There is absolutely nothing wrong with having your children bring home a Dickens novel, let's say, from which you read aloud one chapter while they read another on their own."

Reading aloud costs nothing except time. Its only flaw is that it favors children from homes where books are no strangers. That should underscore the importance of building daily reading into early childhood education and child-care programs for poor children.

Finally, reading aloud is not some new-fangled idea. Such readings, for adults as well as children, were part of the American household in the early days of the Republic.

BOOK REVIEW: THE SECOND SELF

Virginia Small

The Second Self is quite a book on thinking and computers. Author Sherry Turkle states, "Computers, as marginal objects on the boundary between the physical and the psychological, force thinking about matter, life, and mind. Children use them to build theories about the animate and the inanimate and to develop their ideas about thought itself." Ms. Turkle said she followed Piaget's method of not only asking the children direct questions but also observing what they did with the computer and computer toys. She observed that at different times children would state these objects were "not alive" but then their actions betrayed these statements. She also observed children playing with the computer such as "killing it" by "crashing" a program then reviving it and possibly working through feelings about beginnings and endings and life and death. "They play with and manipulate objects to get a sense of control over their powers."

"Children construct theories that will help them situate the computer in the world of living and non-living things and neutralize what seems threatening about it." "Piaget argues that children develop the concept of life by making finer and finer distinctions about the kind of activity that is evidence of life. In particular, the notion of life is built on progressive refinement of their concept of motion."

Ms. Turkle observed that, "the most common psychological attributes that children mentioned in discussing the question of the computer's aliveness were intelligence, feelings and morality." The last attribute of aliveness mentioned, morality, is referred to frequently in deciding whether the computer toys were cheating since they won frequently. Ms. Turkle expresses the feeling that thought and feelings are inseparable. She feels that this complex relationship should not be taken apart and she is concerned that children will try to separate the two with computers leading to "mechanical views of the mind".

I was certainly amazed when I read about the video games that were discussed in this book. These games have quite a holding power for the children. Children like the feeling of power they have when they can master these games. Sometimes in the real world these children feel cut off from their own peers or family and they feel they have no control, but mastering these video games does give them some control. I was further amazed to read about some of the video games that were available. Some actually present pictures of places seen in movies such as "Gone With The Wind" and you are one of the characters choosing a door to open or a street to venture down. One big difference with these computer games is that these games follow rules which the real world does not. One of Sherry Turkle's concerns was the danger of becoming so interested in the simulated world of computers that you prefer it to the real world. "For many people, what is being pursued in the video game is not just a score, but an altered state." Some people use this total type of concentration as relaxation. They can't think of anything else. People who feel they don't measure up to their real world use the computer for a measure of "perfection". This gives them "control" the don't have with the world. Others dislike video games for the same reason - if you handle the games wrong they don't work and anxieties are produced.

What is happening to the young children who are introduced not only to computers but also to programming? "Computers bring writing within the scope of what very young children can do. It is far easier to press keys on a keyboard than to control a pencil. Rousseau considered this a real danger and loss of innocence, a loss of direct contact with other people. "If childhood innocence is eroded by writing, how much more so by programming?" Can computers change the way children think?

One of the schools observed was one she called Austere. At this school all children had access to computers. This school used Logo as the language and followed the natural learning of Piaget. It was found children can learn a great deal without being taught. Once the children "learned" on their own they felt it belonged to them and not just the teacher. Sherry Turkle says a child developes a style of mastery which she calls hard and soft. Hard Mastery imposes will over the machine, the planner or engineer. The Soft Mastery is the artist, try something and see what happens. Hard masters see the world as something to accomodate to. The "hard" mastery type children find the "give and take" of the average playground more difficult to cope with. When Sherry Turkle speaks of this mastery gender she states that girls are mostly the soft mastery since in our culture girls are taught negotiations, compromise and give and take.

As the book progresses examples of responses of children to computers are given. An outstanding one was Tanya who was in the fifth grade and had not written, couldn't spell, add or subtract. When she was introduced to a computer in the sixth grade she began to write. She had been ashamed of her writing. The computer gave her a chance to write in her own way so she would have a product she was proud of. Corrections were made easily. She personalized her computer by naming it Peter and would sign her letters and stories by both names. Tanya created poems and as she graduated she left a book of her poems for the library.

Computers go further to provide more understanding between "worlds" that people become divided into. The examples given were Michael and Ralph with different interests getting together at a common interest on the computer. Although these boys didn't become close friends they learned to appreciate the other's interests and abilities.

Computers can also cause some children to withdraw more than they should. As two boys were compared, Jeff and Henry, we find that they are actually in competition with each other, although Henry seems more intense than Jeff. With Henry "machines" kept him from becoming involved with people.

Chapter four deals with adolescence and identity; finding yourself in the machine. One example used was about Deborah who had "found" herself through the computer. She had had a "troubled" growing up period and had not done well at school, where she had been treated as a baby and had not responded well. She had run with the "wrong" group of children and considered herslf a loser. After she was introduced to computers, she at first continued to feel dependent always wanting the teacher close. One day she discovered a rule that would allow herself one turning command. It was a right turn of 30 degrees. After this discovery she began to "draw" flowers, stars, rabbits, etc. She liked the computer because she put her feelings into it. She learned independence and self control. For the first time she was successful at something. She felt when she programmed the computer she was sharing some of her mind which beame a little piece of the computer's mind. When Deboraah graduated from the eighth grade she no longer had easy access to the computer. She had turned to drawing. Unlike some Deborah didn't become dependent on computer use.

Bruce is another example of computer usage. He was and is a chaotic person and programmed in the same way. He would rather retype a whole program than use an insert of new instructions. Bruce had a fear of being typical and liked unpredictability and variety. He didn't want computers to take variety out of people. His type of programming reflects his way of thinking. Another example is Carla. She had been taught to do things and to do them in order and she felt she in a way had been programmed like a computer. She feels programs can be changed when you learn how and in some way she feels she can change her life of order when she learns how.

Dennis is the son of a professor who is very successful and intellectual. Dennis thinks he is like his father. Dennis began to work with computers and to program around the age of 10. Dennis says you can get involved with computers at different levels to do the type of programming that you want. Dennis coompares this to his and his father's behaviors. If he didn't want to be like his father he thought in terms of reprogramming as a way out. Sherry Turkle says these ideas of Carla and Dennis are the "first step towards playing with the idea of mind as machine, personality as programs." George was another person, who through work with computers, found a better adjustment to his life or real world problems. Programming was the first thing he had done that wasn't required of him. " ...computers change the way people think especially about themselves."

One of the chapters discussed personal computers with personal feelings. Adults are slower to accept changes and leave things that are certain. Children adapt more easily. Computers are causing changes in both groups. Computers can cause people to reconsider ideas about themselves and can provide "a basis for thinking about large and puzzling philosophical issues." The computer has been described by users as "building another room in my mind". An example given was Berry who had lost some respect of himself due to the fact he felt he couldn't do the kind of math he thought he could. Now he has mastered the math and sees himself as a learner through his use of the computer.

People with home computers develop a sense of power from understanding the system and feeling in control. Computers were first thought of as making people less personal in relationship to others. Much the opposite happened. Computer clubs sprang up, interests shared, and cooperation in use and information developed.

Sherry Turkle compares programmers to race car drivers "those who pursue risk and those who avoid it". I had always wondered what a hacker was and she tells us "hackers" are users "with a subculture of programming virtuoso devoted to programming as an art in itself".

We are told that computers have different dimensions. One dimension is the intellectual. "The corner of the personal computer which they felt was the greatest intellectual integrity, which distilled the best ideas in computers science was the CPU." The second dimension was the "computer holding power". There is a relationship between you and the computer such as working with Logo. "Becoming the turtle" to feel the moves and feeling that is directly psychological. A third dimension is the relationship of you and the CPU. If anything goes wrong it's between you and the machine.

Another chapter in the book was devoted to the discussion of "hackers". Hackers are described as loving the machine for itself. Hackers have been criticized both inside and outside the computer community. One paragraph I felt important was this one: "Pride in one's ability to master a medium is a positive thing. But if the sense of self becomes defined in terms of those things over which one can exert perfect control, the world of safe things becomes severely limited-because those things tend to be things, not people. Mastery can cease to be a growing force in individual development and take on another face. It becomes a way of masking fears about self and the complexities of the world beyond. People can become trapped." "They (Hackers) are addicted to playing with the issue of control. And playing with it means constantly walking that narrow line between having it and losing it." People whose lives beome so involved with computers think of their work "out there" and they are "in here" and sometimes become so involved that they lose track of the "ins or outs".

Sherry Turkle tells us the "hard core" people of Artificial Intelligence are sure that eventually "machines will exceed human intelligence in all respects". The AI people feel sure if you are sick you will consult a computer and if you have a technical problem in industry you would consult a computer. "Edward Fredkin of MIT puts it "Artificial Intelligence is the next step in evolution." AI tried to find out how to program machines to do certain acts people do. They have also worked to see if programs can model after children's thinking. There are a lot of discussions and information of this subject but I think I like the remark given by a twelve year old who said, "When there are computers who are just as smart as people, the computers will do a lot of jobs, but there will still be things for the people to do. They will run restaurants, taste the food, and they will be the ones who will love each other, have families and love each other. I guess they'll still be the ones who go to church."

JELLY BEAN MATHEMATICS

Lucia M. Norris

Have you ever wondered how many jelly beans different sized containers could hold? I took this task to a group of fourth and fifth graders. The students were given a ditto with four different sized containers drawn on it, and were told container A could hold about 58 jelly beans. From that, they were asked to find out approximately how many jelly beans would be in containers B, C, and D.

I was interested in finding out how well children could apply mathematical "mechanics" such as addition, subtraction, multiplication, and division. Secondly, this is a visual problem because children have to compare the size of the three unknown containers to the known one.

The problem was set up with container A as a rectangle; container B twice the size of container A; container C half the size of container A; and container D four times the size of container A. (The students were not told this information.) It was stated that container A could hold 58 jelly beans. The students were asked to show their work.

The results were overwhelming.

Many of the fourth-graders added 58 + 58 to get the answer for container B. A few multiplied 58 x 2 for the answer. I went back and interviewed the others and here are some of their responses for the answer to container B.

a) I drew a box at the bottom of the page, drew little circles in it, and then counted them. I got 86.
b) I thought B was three times larger than A, and put 174.
c) I knew that 50 was half of 100, so I added 50 + 50.
d) I added 50 + 50 and knew that was 100, and 100 is twice as large as 50.
e) I looked at container B and guessed 100.

Container C created even more interesting results from this class. No one used division. Three children showed the problem 58 - 29, and when asked where the 29 came from, the following answers were given:

a) I knew 15 + 15 = 30; 20 + 20 = 40; 25 + 25 = 50; 30 + 30 = 60; so I started at 26 and counted up to 29 + 29.
b) I knew 25 + 25 = 50, and 30 + 30 = 60, so I worked back from 30 and added 29 + 29.

The others who did not have 29 for an answer gave the following reasons for their answers.

a) I drew a line from C to A, and knew that C was half of A. Therefore, half of 58 is 28.
b) I took half of 58, which is 30, and then subtracted 30 from 589.

c) I looked at A, and guessed 20.
d) I thought C was half the size of container B, and my answer to B was 115. I took half of 115 (in my head) and got 61.
e) I knew 34 + 34 = 58, so I put 34 as my answer.
f) I used my fingers to compare container C to container B. Then I guessed 10.
g) I looked at container B, compared it to C, and guessed 10.
h) I knew 20 was half of 58.
i) I drew squares at the bottom of the paper and looked at them, then guessed 13.
j) I drew marks on the container A and figured that 10 container C's would fit in container A. Then I subtracted 10 from 58 and got 48 for my answer.
k) I looked at B and thought it was 10 times larger than container C, so I put 10 in container C, but then I added 2 to the 10 because I had guessed, and 12 is my answer.
l) I knew that 30 + 30 = 60, so I subtracted 30 from 58 and got 28.
m) I thought 24 was half of 58, and I subtracted that from 58, and got 34.
n) I knew that container C was half as big as container A, and I also knew that 30 + 30 = 60, so I put 30 as my answer.
o) I can't remember why I subtracted 10 from 58 to get my answer of 48.
p) I put 34 or 24 because I could not decide which was half of 58, but I knew that C was half the size of container A.
q) I knew that 30 + 30 = 60, and 58 is 2 less than 60 so 28 is two less than 30; therefore, 28 is half of 58.
r) I saw my answer to B was 116, and saw the 11 in 116, so I took 1 x 11 and figured that 11 container C's sould fit in container B, and my answer is 11.
s) I thought half of 58 is 40.
t) I saw the 16 in my answer of 116 in container B, so I added 16 + 16 to get 32.
u) I looked at container B, and guessed that 98 was half of 116.
v) I thought that 21 was half of 58.

These answers showed me that the children were thinking, but could not apply the "mechanics" of division to arrive at the answer. Container C proved more of a visual problem for many students.

Container D had just as fascinating results for answers. A few students added 116 + 116, which showed they had compared container B to D. One student multiplied 116 x 2. Many made a column of four 58's and added. One boy wrote "step 2" and showed 16 + 16 = 32 next to his four 58's. One person thought container D was three times larger than A, and had 174 for his answer. The reasons for the other answers were as follows.

a) I added 58 + 116 in my head and got 165, and then I added 58 more to get 223.

b) I looked at container B and thought that B and half of container A would fit in D. I thought 23 was half of 58, so I added 116 to 23.
c) I knew that container B was twice the size of A, so I put marks on containers B and D, and then guessed 1000.
d) I drew boxes at the bottom of the paper, and put marks inside them, and guessed 98.
e) I looked at container D, and then A, and knew it was 4 times larger than A, so I multiplied 4 x 58 = 150
f) I looked at container D, and knew it was 2 time larger than B, so I multiplied 116 x 2 and got 1000.
g) I thought container D was 5 times larger than B, and my answer to B was 100, so I multiplied 100 x 5 and got 500.
h) I looked at container D and just started thinking of numbers and I added 178 + 178 to get my answer.
i) I added my answers to B (108) and C (21) and got 129.
j) I added my answer for A (58) and my answer for B (100) and C (13) to get 171.
k) I added all my answers for A,B,C, (58+116+48) and got 222
l) I looked at A, and then D, and just guessed 1000.
m) I looked at B, saw my answer of 116, and added 100 to that and then added 216 + 216 = 432.
n) I thought of some big numbers and took 96 x 32 and got 282.

I was intrigued by these children's thought processes.

The results from the fifth-grade class were just as interesting although more of them showed multiplication and a few showed division for their answers.

Their answers for container B were about evenly divided as far as showing 58 x 2 and 58 + 58. The variations to this were as follows.

a) I added 58 + 8 and got 79.
b) I drew circles in container B and then counted 207 of them.
c) I thought B was 3 times larger than A, so my answer was 174.
d) I added 58 + 58 =116, but I wrote 166 in the box.

Their answers to container C were also varied although a few answered this problem correctly by division.

a) I looked at the number 58 and then took 3 x 8 because container C is in the third place (on the paper) and got 24 for my answer.
b) I knew 30 is half of 60, so I subtracted 30 form 58 and got 28.
c) I figured out in my head that 34 + 24 is 58, so I subtracted 34 from 58 to get 24.
d) I started guessing what 24 + 24 is, and kept going until I reached 29 + 29 = 58.
e) I knew that 25 + 25 = 50, so I kept going from there.
f) I looked at container C, knew it was half the size as A, and I knew that 24 is half of 58, so I subtracted 24 from 58 to get

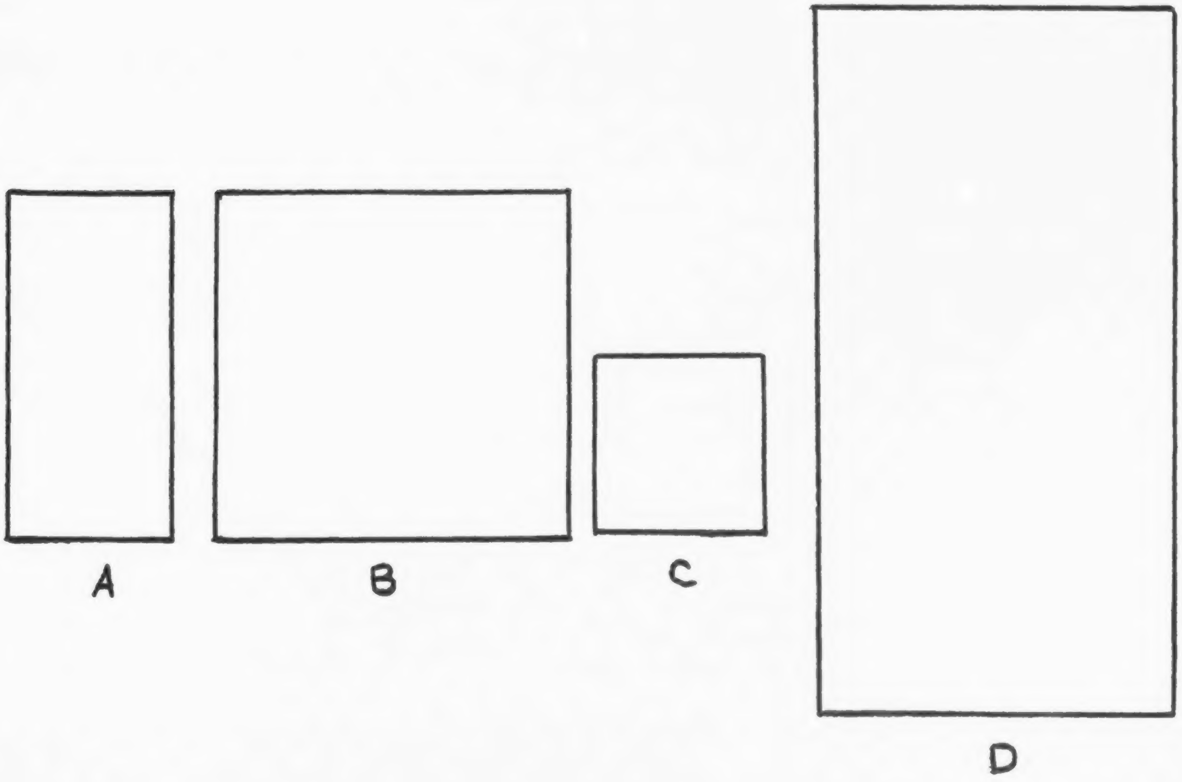
24.

g) I looked at container C and figured it was smaller than half of container A, so I just guessed 15.
h) I looked at container B and then subtracted 100 from my answer to B (174) and got 74 for my answer to container C.
i) I looked at my answers to containers B and D (which were correct) and I thought about those numbers (116 and 232) and then just guessed 10.
j) I looked at container C and thought that 49 would fit on one side, and that 58 would fit on the other side, so I added 49 + 58 to get 107.
k) I knew that 30 + 30 = 60, and I knew that 28 + 30 = 58, so I put 28 as my answer.
l) I looked at containers A and B, and kenw that one A would fit in B, so I subtracted 58 form 116 and got 48 as an answer.
m) I looked at container C and marked off its size on container B. I figured C would fit 4 times in container B, and then I thought if C could hold 10 jelly beans, that would be 40 and then one C would hold 10 jelly beans, so I subtracted 40 from 48 and got 10.
n) I thought container C was 1/4 as big as A, and my answer is 14.
o) I made a mistake -- I subtracted 2 from 58 and got 24.
p) I looked at the shape of container C and guessed in comparison to container B, and then just thought of the number 110 and subtracted it from 116 to get 15.
q) I put dots inside container C and counted 77 of them, and added that to 58 to get my answer of 135.
r) I looked at container A and just guessed 45.
s) I looked at container A, and thought of 49 and subtracted that from 58 to get 9.

The fifth-graders had few difficulties with container D. Several multiplied 58 x 4; several added 58 four times in a column; and a few added their answer from container B. The others had the following responses for their answer.

a) I looked at container A, and took 58 x 58 = 3364 because I thought D was that much larger.
b) I looked at container B, and just guessed 200 for container D since I had 79 for my answer to container C.
c) I put marks in container C and counted them and got 245.
d) I looked at container C and thought 8 of them would fit in container D, so I multiplied 8 times my answer of 15 (for C) and got 120 for my answer to D.
e) I looked at container B and thought it would hold one of them plus one container A, so I added 116 + 58 + 174 to get my answer to container D.
f) I made a multiplication mistake and got 204 for an answer to 58 x 4.

In conclusion, I feel this experiment caused children to think about numbers and sizes of shapes. Perhaps I would use marbles instead of jelly beans if I were to do this again. I also feel that this experiment would be a good assessment skill to check mathematical "mechanics".



BOOK REVIEW: THE POLITICS OF EDUCATIONAL INNOVATION

Doris A. French

Daily, our schools are faced with the innovation of computers - which kind to buy, how many, which software to use, who will teach and who will direct the program. Shedding light on the process of innovation is the book, The Politics of Educational Innovation, by Ernest R. House.

The author discusses the implementation of innovation in education. In his prologue he states, "Education can deviate only in the direction and to the extent that society allows." He premises his discussion of the forces that make for change by stating that "direct personal contact is essential to the propogation of innovation" -who knows whom and who talks to whom. Large-scale change programs often fail due to the overuse of newsletters and conference methods. Increasing personal contacts will speed up the dissemination of information. What is totally lacking in our schools are networks that bridge different types of educational personnel.

A powerful force behind innovation is the educational entrepreneur who is defined as "a person who initiates, organizes, and provides direction." He may be a teacher, or even a parent, but within the school structure, he is ordinarily an administrator.

Between the superintendent and the teachers lies the central office staff (COS), those people the superintendent gathers around himself to help him run the school district. "Most studies portray the COS as inhibitors of change, but they have the capacity to facilitate as well as to inhibit."

The school board almost always accepts COS proposals. Usually proposals by outside groups are intercepted by the COS before they get to the board. The COS needs to perceive itself as being in control of a situation. It is clear that someone pushing for an innovation has to build relationships with COS members.

When a superintendent decides to introduce a change, the first hurdle is the COS. Then teachers must be persuaded to utilize the change. This persuasion is "the most difficult task."

Change often creates conflict within groups in a school. New programs often encroach on old ones. Resources must be reallocated. Groups are in competition for these funds. Change is not often recognized on its technical merit; it doesn't sweep through a school. It requires time for development and adoption.

The teacher is the ultimate consumer of educational innovation. Although the teacher does not usually initiate an innovation, he decides whether he will use it or not or the degree to which he will use it.

The teachers' contact with innovation is limited. "Their heavy teaching load confines them to the classroom, which greatly restricts access to new ideas and innovations." Much of the initiative in a school is in the hands of the administrative staff.

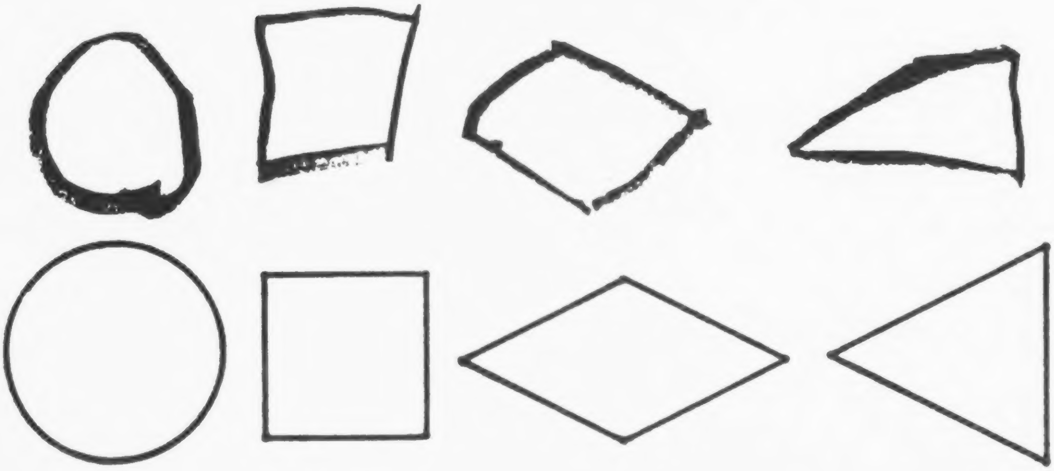
The teacher has the problem of deciding how much of an innovation to "purchase." He must presumably give up some part of his traditional instruction in order to accommodate the innovation. The benefits of each must be evaluated.

The author indicates studies showing that teachers participate more readily in innovations when they are allowed released time for training. Another inducement for participation is the prospect for career advancement.

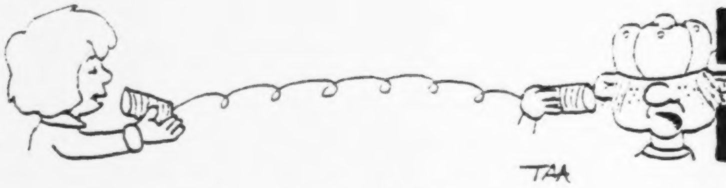
"The basic predicament of teachers is that they are treated as passive consumers within their own organizational structure." The resources and power to initiate change is not theirs, but "the power of refusing to participate in the innovation is the one important power teachers can exercise."

After developing the underlying principles of educational change, the author then describes the actual procedures followed in introducing PLATO (a computer-assisted teaching system) at four junior colleges. He discusses the impact of PLATO on the teachers involved. He points out that innovation has a different impact on teachers than on administrators. "The rewards are greater for those higher in the hierarchy and the costs are greater for those lower." Teachers must struggle to learn new skills in spite of limited rewards and resources. "They are also usually blamed if the innovation is not properly implemented." Trying to innovate in an economy of scarcity leaves teachers disillusioned and frustrated at the lack of time and resources placed at their disposal.

House ends his discussion on change and its impact on our schools and on society as a whole with a strong challenge to teachers. "Critical to the future of educational innovation will be whether the organized teachers decide to "buy in" to the system, in the way that American labor unions have tended to do, or whether they will decide to defend and promote the humanistic values of their institution."



#: 7333 S6/Parent Line
23-Apr-85 21:58:28
SB: #Gifted Students
FM: Suzanne Schurrer 75156,1614
TO: (FO) All



I am the parent of three (yes, 3.) gifted and talented students; one child has been tested out at an 'avg. IQ 157, that's the guidance counselor's terms, I don't pretend to comprehend; the other at 161 and the last at 148; the problem I am having is a small school district with no teachers or programs for this type of student. The girl's are mainlined in the regular program and bored; one in particular uses her "brains" to break the monotony by playing practical jokes on others, preferrably the teacher.

(She's too talented in that.); my problem is that the teacher "retaliates" and labels Brenda's antics as "stealing", there is a lot of hostility; there is no other placement for the child; query: the problem is becoming severe enough to where the other children are teasing my daughter about being a thief--even though the various parents indicate that they all thought the pencil incident was a joke until the teacher had Brenda stand up and ordered her to repeat "I am a thief". How can I constructively reach the teacher that this is not the correct method and that it is doing nothing but creating hostility. (My daughter is 8)

Please help a desperate parent???

#: 7334 S6 Parent Line
24-Apr-85 13:28:48
SB: #7333-#Gifted Students
FM: Jim McCauley 70014, 1136
TO: Suzanne Schurrer 75156, 1614 (X)

I am not a professional counselor, but here are some common-sense suggestions:

1. Make sure that you and your daughter's relationship is strong before taking any other action. Discuss her practical jokery with her so that she has a chance to explain out loud to herself just why she does these things. Certain people seem to be able to get away with this sort of thing (Steve Wozniak, the co-founder of Apple Computer, was and still is an inveterate practical joker), but others are not easily forgiven. A complicating factor is her gender; discriminatory as it may be, boys are forgiven their high spirits, but girls are expected to be ladies.
2. Try to establish a cooperative relationship with her teacher, and with other teachers in the school as well. If your daughter's gifts express themselves in academic excellence as much as they do in attention-getting, see if there are ways in which her talents can be channelled positively. Gifted children often benefit from acting as

peer tutors for other children; not in terms of academic advancement, but rather in learning how to handle the marked differences in performance between themselves and others. In working with the parents of gifted students in the past, I have noted resentment on their part when it is suggested that their children spend time helping other students instead of working to maximize their academic potential. I beg you not to fall into this trap. If your daughter is as gifted as you think, her need to develop the social skills necessary to prosper and be happy is far greater than her need or academic study.

I once heard a gifted-and-talented educator characterize certain children as "severly gifted" -- implying that giftedness can be as socially disabling for children as retardation can be. Your children will be identifiable as "different" for the rest of their lives, and the loneliness that can breed is the greatest threat against them. Now is the time to begin equipping them to deal wih it.

#: 7341 S6/Parent Line
24-Apr-85 22:51:19
SB: #7334-#Gifted Students
FM: Suzanne Schurrer 75156,1614
TO: Jim McCauley 70014,1136 (X)

Thank you for your suggestions. They are sincerely appreciated. I will take efforts to implement; since I had not wanted first message to be an epistle, many background items were omitted. But nonetheless appreciate your thought provoking suggestions; hopefully we can channel her energies into the studies so they will allow her the tutoring;

Thus far her "differentness" has been a major problem; the others won't accept her as is so she has become the clown; by the way, this wasn't the first of her practical jokes--only the one in which teacher over-reacted (I feel) by labeling it "thievery" rather than another of the endless "comics".

Hope to hear from others with same problem; I can definitely understand the comments regarding "severe giftedness" since it has become a very severe problem.

#: 7342 S6/Parent Line
24-Apr-85 23:41:47
SB: #7341-Gifted Students
FM: Tony Stavely 75766,3122
TO: Suzanne Schurrer 75156,1614

I like Jim's suggestions a lot. The only thing I might add is that you support the development of expressive and creative interests in your "severely gifted" children. Along with the social skills Jim mentioned, it is important for all of us to have a sense of competence and of specialness and to have something to contribute that is an expression of our particular talents. My own children have each had a particular area of specialness since preschool times - my 15-year old son has drawn cartoons sine he was four and my 10-year-old daughter is an actress. Without those distinctive "talent centers" I think they'd have a hard time just being bright.

#: 7348 S6/Parent Line
25-Apr-85 12:04:39
SB: Tom O'Brien 76703,450
TO: Jim McCauley 70014,1136 (X)

What an immensely thoughtful response, Jim. One other bit of advice from someone with 60 cumulative years of the same problem; help your kids to become self-sustaining in their inquiry (and not deadened by school stuff) by providing a rich arena in the home. One major, proven, tactic is to read quality stuff to them and encourage their own private reading and writing. Sad that the schools cannot address the problem healthily. What would they do, on the other hand, if they had an incredibly gifted basketball player on their hands? They'd turn the world over to accommodate that person.

#: 7351 S6/Parent Line
25-Apr-85 13:47:51
SB: #7348-Gifted Students
FM: Jim McCauley 70014,1136
TO: Tom O'Brien 76703,450 (X)

I have always been irritated by the notion that gifted children will "make it" anyway, whether they have assistance or not. Intellectually, the gifted can go wildly astray, and they are almost certainly headed for a lifetime of emotional turmoil unless they can find good counsel and accept it.

From Data Library G. Hom-137, A summary of several previous messages from Judy Pope:

Two approaches to the problem of mustering scarce resources have been very successful for our school district. The first is a parent organization very different from the normal PTO/PTA type of fund-raising group. We have formed this network in order to support excellence in education, and to promote vital interaction between the school and the community. Some of the things we do are:
--Attend all school board meetings and keep open channels of communication between the adminstrator, teachers, parents, students, and community members (top priority)
--Publish the school newspaper (edited and printed right here on my QX-10)
--Bring in artists, storytellers, and other performers from other areas (including two artists-in-residence this year)

--Sponsor the annual welcome-back-teachers luncheon, open house nights, dances for students and community, etc.
--Print note cards to sell, with works by students as well as prominent local artists
--Make ourselves available for chaperoning all sorts of school activities (which often includes instigating those activities.)

None of this directly affects the gifted students exclusively, but it gives all of our children a great deal to enjoy about our schools. A related and equally welcome change is that now many community members have become involved in "their" schools, to the extent that we can begin to expect support or such controversial programs as the gifted classes.

One thing that our gifted program has accomplished recently is to join forces for a county-wide committee of gifted program coordinators and administrators. The first major project was to conduct an inservice for the elemntary teachers, to help them develop "interest/challenge centers" for their quick learners. Parents are encouaged to come in to shool to oversee these centers, which will also be shared among the schools. Getting the teachers to develop specific resources for their own gifted students has taught many of the most reluctant ones what a tremendous challenge it is to serve the needs of these children. Their proud sense of ownership in these wonderfully creative centers has also helped many of them overcome their former prejudice against anything remotely connected with the label "gifted." And it is no small achievement. --Judy

#: 7525 S6/Parent Line
09-May-85 23:04:24
SB: #7486-More of Same
FM: Judy Pope 72355,161
TO: Tom O'Brien 76703,450 (X)

Here are the addresses of some publications for parents as well as teachers of the gifted which I especially recommend:
--Gifted Children Monthly, P.O. Box 7200, Bergenfield, NY 07621
--G/C/T (and its offshoot by/for kids called Chart Your Course.)
P.O.Box 6448, Mobile, AL 36660-0448
--Good Apple's Challenge, Box 299, Carthage, IL 62321-0299. --JUDY

#: 7577 S6/Parent Line
14-May-85 23:41:48
SB: #7566-(Cont.)
FM: Sandra Newton 72456,2511
To: Judy Pope 72355,161

Judy,

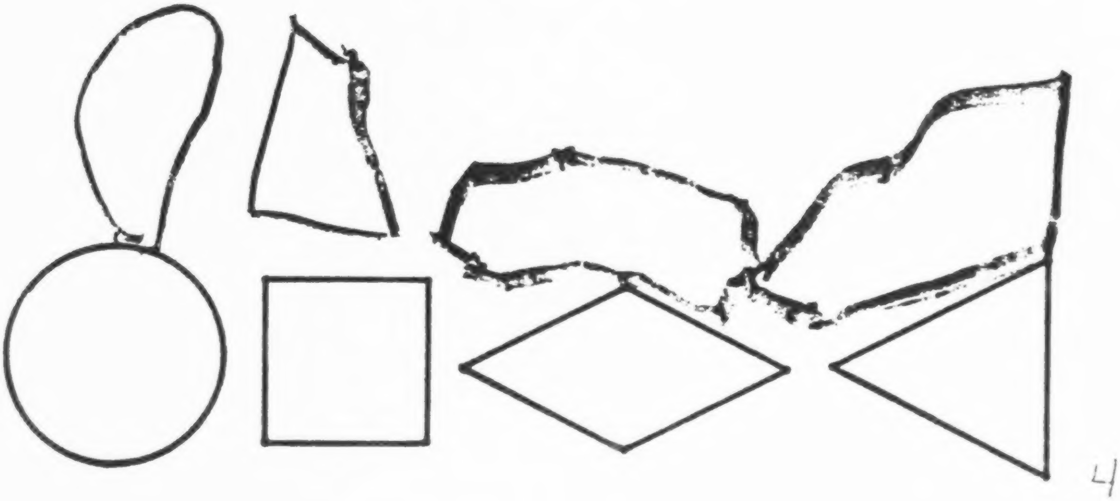
Good to hear from you, too. (I've been lurking, just browsing, and reading these days.)

Re my son's gifted class. Because it meets a full day once a week, he's gained a new perspective, partially, on school. On Tuesdays, he pushes me out the door to drive him to school. Alas, it's only on Tuesdays, and the rest of the week is still as awful as it's been for four years since he hit fourth grade and turned off.

I have mixed feelings about the program (as a parent, not as a teacher). I love his new enthusiasm, his application of intellect, his renewed interest. I love seeing the potential fulfilled. And, of course, I also like being vindicated in my own thinking that all he needed was someone and something to "tickle" his mind.

The other side of it, though, is less cheery. He dislikes his traditional classes more than before; he rebels more openly against work that seems pointless to him (i.e., "Mom, why do I have to do twenty math problems when five or ten demonstrate that I understand?"), and he is still turning his energy to finding ways to avoid the work when possible (and shrugging in his maddening nonchalance when called to task). So, now that he's "publicly" gifted, he more clearly understands just how deadening and boring his other classes can be (as he suspected all along). Is the program good, then?

From a parent's point of view: I dunno. Any thoughts?
--Sandra



CUTTINGS

Teachers who come to the Teachers' Centers turn in a weekly diary. In it they've written about what they've been reading, activities they've tried with kids and their observations of children's thinking along with general comments they wish to make about what they've been thinking, reading, doing and observing.

Many of these diaries contain material that is too good to remain buried in someone's file; it begs to be shared. So, in "Cuttings" we've simply lifted parts of individual diaries and reprinted them. Read them, think about them, share them, help them grow.

CUTTINGS

Barbara Goldenhersh

The preschool and primary classroom offers an infinite variety of exciting concepts apart from the typical idea of classroom math. With its sense of discovery and curiosity, these concepts can form a basis for a future understanding of so much of the structure of the world around us. Following is a sample of such activities and observations which offer chances to develop and generalize these concepts.

I asked the children to follow directions, ie. sons stand up, daughters stand up. Using a variety of variables, the children were beginning to see parts to a whole as they thought through their relationship to others in the class.

I asked the girls to stand up to count themselves. Then the boys stood up to count themselves. We found the boys had to stand on the edge of the rug so we wouldn't lose count because there are so many. What a marvelous discovery for 4 year olds.

Two children with similar shoes came to the front of the group and the kids told how their shoes were the same and how they were different. This is very popular as children at this age are always noticing shoes and find new shoes to be quite exciting.

Children were called to activities by a specific designation, i.e. hearts, letters, numbers, etc. on shirt. I introduced vocabulary such as, stripes, plaids and solids here (I often try many types of variables like colored fall leaves, numbered pumpkins, etc. The choice can fit in with any subject).

We played a game I call Mr. Policeman. All the children stand up and I begin by calling for a variable. "Mr. Policeman, please help me find my daughter." All the boys now sit down. I continue to call out single variables, ie. brown hair, blue shirt, red pants, etc., until one child is left. Later in the year I will ask a child to take my part.

An exciting math experience occurred when I had the children stand on the edge of the rug and count off. I had expected them to have difficulty with counting off but, with the exception of the child who said 4 & 1/2, they did quite well. We got to 17. I then told them there are 22 in our class and we counted from 17 to 22, holding up fingers for each number, and found that 5 were missing. When one of the children came in, the children said there were now only 4 missing.

In our process of counting the children to see how many are missing, I tried to help them narrow choices. We found there were 21, indicating that 1 was missing. We then counted just the girls to see if they were all there. That day it was a girl missing and they figured out who was absent. Another day I will have them count the group that is all there to see whether they want to count the other group or can make inferences as to who is missing.

I used 30 1" cubes to present the problem "Show me 24". Matthew lined up o, added three more, and said that's 24. David counted all 30 "twenty-ten", lining them up by adding blocks at random to either end. He did not respond to my reminder that I needed 24. Adam piled blocks with no attempt to count. When I asked how many there were, he counted quickly and inaccurately up the row to 8 and said, "I need more." After the tower fell twice, he said, "I can't pile 24. I can make rows of 24." He made a row of blocks 2 high using 30 blocks. He was unable to accurately count them 1 to 1 so I pointed to them as he counted. When we got to 24 I asked what we should do. He said, "Take the rest away," but proceeded to remove a random group. The remainder of the children built towers and made no attempt to address the problem.

We use a variety of manipulatives in our preschool classroom. I generally have such materials out for play and unstructured manipulation before asking them to perform specific tasks with these materials. It is too early in the year (November) and the toys and materials are too new to them. This gives credence to my usually waiting a couple of months before adding "learning games" in which specific tasks must be addressed with 4 year olds. They are quite willing and eager to spend group time on math concepts, but play time is still too precious to give up to a teacher-guided task.

Using the calendar, we counted the days to Halloween and talked about yesterday, today and tomorrow. We counted the "empty" spaces to the pumpkin to tell how many days to Halloween. We then used body parts to say how many that was. We found we had 10 fingers on our hands and 10 toes on our feet and added other body parts to make the correct number. We counted by 10's and added two eyes, one nose and two ears to get 25 days. When we got to 19 days we counted by fives using 2 hands, one foot, 2 eyes and 2 ears.

We counted backwards as I removed the numbers from the calendar. The teens were very hard for them and I introduced the "onetys" (eight, nine, onety, onety-one, onety-two...). (Tenty sounded too much like twenty and was too confusing when I mentioned it a few weeks ago.)

I asked the children to guess what number I am thinking of. Using the calendar, the children guessed my number. I gave clues of more than and less than. They did amazingly well but need a better understanding of more and less. I plan on putting up numbers with felt shapes beneath each number so they get a better idea of this concept. Also, I want to try removing the numbers they ask as they lose track otherwise.

I put the numbers from 1-10 on the flannel board. I had them show me numbers with their fingers as I said them. We then talked about numbers being more or less according to the number of fingers it took to make the number. With that knowledge, they were able to guess the number I was thinking of with much greater accuracy than last week. (I moved the numbers as they guessed to a position lower on the flannel board to help them keep track of those already asked)

We are continuing to talk about more and less. We have been holding up the number of fingers it takes to make a number and then saying which is more and which is less. The children are beginning to develop a deeper understanding and are often able to answer without fingers or are able to use their own fingers instead of my model to find the answer. They have taken the concept and made it their own.

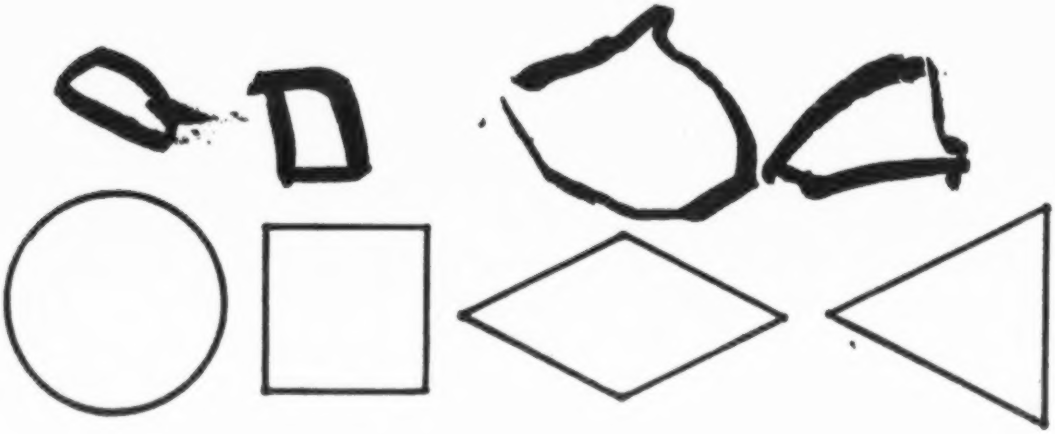
I set up a situation in which the preschoolers could make an assumption and test it out. Holding up a leaf, I asked them to guess whether it would fall fast or slow, whether it would fall straight or "wiggly", whether it would bounce or not, whether it would be quiet or noisy. I then dropped it to find out. I did the same thing with an acorn and a buckeye. I did this several times giving them a chance to feel they could theorize correctly. The children enjoyed the experience and felt confident they could make a reasonable assumption.

I used Look at Annette with the preschoolers. They are entranced by the mirror. It is fascinating to see the techniques used. Many place the mirror at one edge of the picture instead of the middle. They take some time to figure the correct procedure, some having to be shown. Most of the children do not look at both sides of the mirror. When I suggested that they do so, many turned it over to look at the "other side".

How can we ask the child just developing the idea of number to memorize a phone number? Wouldn't this be better taught after the idea that numbers have a specific "numberness" is better understood? If a phone number is required for safety's sake, why not have the phone number in a locket or have it in a pocket, on a belt, etc.

I am introducing graphing by having the children add a sun or a cloud to a graph each day in November. We are discussing more and less as well as observation. Graphing seems an ideal way to show not only the obvious idea of more and less but is an opportunity to make choices and hypothesize. A child might be asked to select which type of cookie they want for snack, whether they are boys or girls, are right or left handed, notice whether they have buckle, tie or velcro shoes, etc. This information can be placed on a large graph using actual representations such as the sun and cloud above, or a symbolic graph by placing the child's name on the graph under their choice. A large graph can be made by creating sections on a trash bag using masking tape. Each child can have a special marker with their name on it.

I used a 1-100 chart and am so pleased at the children's ability to discover what the next number is called. Some of the children are using onety, onety-one, onety-two, etc. for the teens and seem quite at ease with the idea, finding it less complicated. It is interesting, too, to see some of the personalities come into play. There is the child, full of bluster, telling all how easy it is but not having any idea of what is going on. Then there is the child who is very excited and interested in what we are doing but afraid of trying it on his own. With some loving encouragement and a few hints, he did beautifully. This child now runs over to the hundred chart as soon as he enters class and counts before doing anything else. What a difference success makes.



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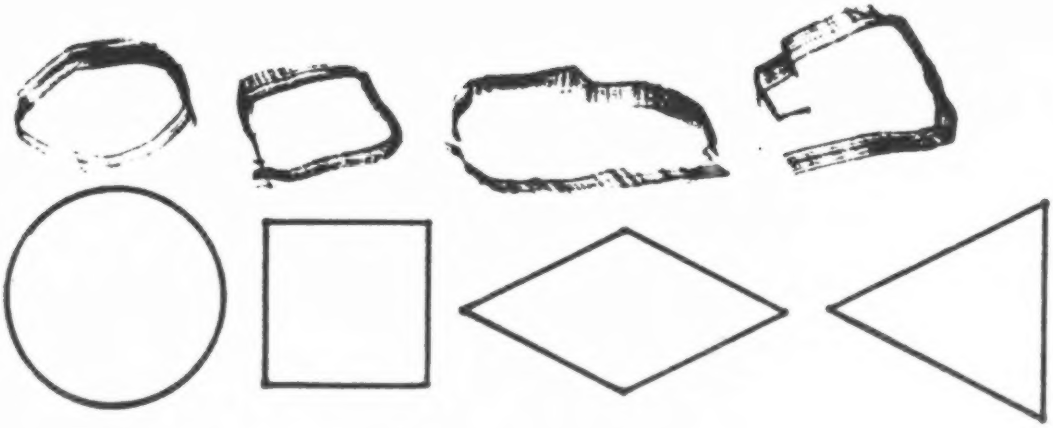


5

CUTTINGS

THE POWER OF OBSERVATION

Carol J. Klekamp

The following diary excerpt describes an observation I did on an eight year old boy, a supposedly slow student, performing the Hidden Counter Task. It was one of my most important observations because it suddenly caused everything we had discussed in class to fall into place.

I placed twenty pennies in front of Andy and asked him how many pennies were there. He counted and said, "Twenty." I told him to cover his eyes, and when he had done so, I put five pennies under my hand. I then told him to open his eyes and asked him to tell me how many pennies were under my hand. Andy said, "Fifteen or sixteen." (He thought I meant the remaining pennies in front of him) I told him I wanted to know how many were under my hand. Andy, looking at me with a slightly worried and flustered face, asked, "Is it cheating if I count on?" I said, "No, you can do it any way you want." After thinking, he said, "There are five under your hand. I asked him how he had figured it out and he said he had just guessed. I was not satisfied with that answer. I wanted to find out more about the process he had used, so I praised his work and encouraged him to tell me more about it. He quickly and proudly said, "I counted on from fifteen and kept track of it in my head.

The observation took just a few minutes, but it was a very worthwhile experience. First, it proved to me every child does possess hidden strengths, and it is the educator's job to find them. Not only did the "not-so-bright" child come up with the correct answer, but he also verbalized exactly how he had done it. I thought it was quite remarkable, because when I gave the same task to some of the brighter children, they had problems solving it, let alone explaining how they did it. We must search for those strenths in each child.

Second, the observation showed how necessary it is to create a trusting environment in which a child is not afraid to express his ideas and solutions. Somewhere along the line, Andy had gotten the idea that the way he solved such problems was wrong, and he was cheating. Given some encouragement, he was able to feel comfortable with his work. It made me wonder how many times children are not able to realize their potential simply because they feel their way is always wrong. We must realize all children are different and learn in different ways.

CUTTINGS
Gary Swalley

Count On?. . . .

Simple counting exercises (so I thought) resulted in an interesting dialogue between these two girls. I found the interaction most interesting in terms of self-confidence (a lack of) and preconceived attitudes about math. I discovered (to my disappointment) that students really are victims of rote learning and find it difficult to adapt engrained methods to new situations.

Melissa and Donna are seventh grade students who participataed in these counting activities. Their conversation follows. Remarks in parentheses are my observations.

ACTIVITY I:

Count by 2's beginning with 17.

Mistakes were: 27, 28, 29 ... 35, 36, 37 ...
started to count by 5's after reaching
49, 50, 55, 60, 65 ...

Donna: I'm not used to counting by even numbers starting with an odd number.

Melissa: I got confused. My brain was doing it without thinking. Got messed up.

Donna: I'm so use to counting by even numbers starting with even numbers.

ACTIVITY II:

Count by 10's starting with 33.

Tended to sequence numbers: 33, 43, 44, 54, 55, 65, 66, 76.

Melissa: They put an extra number in each ten.

(I suppose students were counting on when lapsing into the 43, 44 and 65, 66 patterns.)

Donna: But they increased by one before they did it.

(Interesting to note the subject becomes plural. Easier to identify own mistakes by detaching self from situation or just a way of saving face - I think both.)

Melissa: Did what?

Donna: Huh? Before they counted by tens again, Melissa.

Melissa: Their brain was not functioning right.

Donna: They had adjustable thinking of 10's instead of 2's.

Melissa: But they switched to one's too.

Donna: They're not thinking of numbers by 10's - they're just not thinkin'.

(Again, switching the subject and what about her terminology - adjustable thinking.

ACTIVITY III:

Count by 10's starting with 84.

Began correctly but switched to 100's: 84, 94, 194, 294, 394.

(Thinking 100 + 94 instead of 94, 104)

Melissa: They went by 100's not by 10's.

Donna: Maybe they were taught that way.

Overall observations: Melissa caught on right away and said that was always taught to count by even numbers starting with EVEN NUMBERS. Starting with an odd number really "messed her up." She had to stop and think about what she was doing.

Donna thought the activities were too simple and silly at first. She said that it embarassed her not to count fast. Defended errors by saying that's the way she was taught to do it.

Both girls expressed extreme dislike for math. I commented that the exercises were thinking activities and not necessarily math. Response was that anything to do with numbers was math and they hated it.

Sad to say, these girls were turned off to math long ago by "doing it the way they were taught." I am reminded of this quote in closing ...

"The aim of education should be to teach the child to think, not what to think."

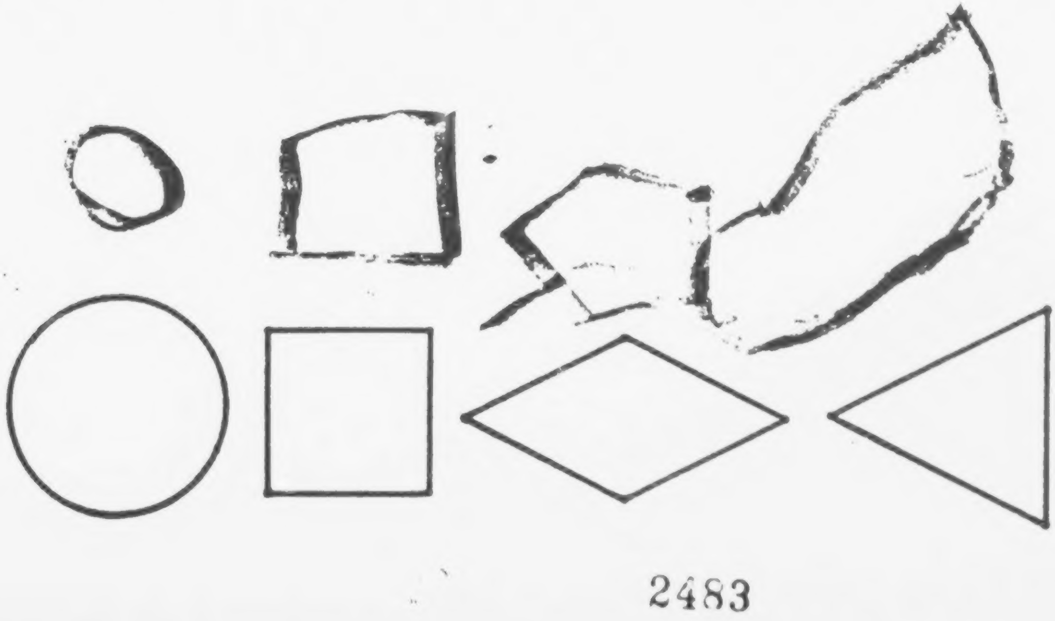
CUTTINGS

Jana Ashford

The students in my fourth grade class have been learning to regroup in addition. They seemed to have mastered the skills well, but I was not sure they understood the whole concept of adding 2 and 3 digit numbers. I decided to have them write a story about adding 64 and 46. Many of the students had no idea what I meant. I interpreted their response as one of "Tell me how to do it". I don't think they are accustomed to thinking creatively. When I was fairly certain they understood what I was asking, I allowed them ten minutes to comply. One boy in front wanted to copy a story problem out of the book. He was quite disturbed about the whole assignment. I think it was because the idea was so foreign to him. He was used to responding to objective questions. At the end of ten minutes I asked some children to show their stories. Some were of the type where "Mary had 64 dogs and John had 46 cats, how many in all?" One girl asked if she could change hers into a subtraction problem. I was impressed by Stephenie's approach to the assignment. She wrote out the situation at hand, something like "Well, we have to find out what 2 things together will make. Let's see. If I had a party and 64 girls were there; then 46 more people came, how many in all would be at the party?" 110 people.

I think she posed the whole problem in her head (and on paper), and, one step at a time, solved it. She first analyzed it, then resolved the problem. Another twist to my question was "Marie had $.64 Harry had $.46, who had the most money?" Amy first wrote a conventional problem, then added the money idea to it. She expanded her thinking beyond the requirements. Dave's story problem was "46 dogs got into the food and dumped it. 64 people came out and yelled at them. How many dogs and people were out there?" I think he was able to take the numbers and use them in his own environment- his own life.

After I was finished with the lesson, I was a little disappointed. I can see how badly students need to be given the opportunity to think.



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CUTTINGS

Ruth Stemler

My task was to watch a child count by 2's. I wondered what the point of this was. It seemed like such a simple task to perform. Was I wrong. The first child I watched was Glenn, second grade. I first asked him to count by 1's, a pretask necessary to watch before counting by 2's. He didn't know what I meant, and replied he couldn't do this. I demonstrated for him by counting 1, 2, 3. By the time I reached 3 his face lit up and he smiled, "I can do that." I had him start at 6. He counted to 10 and asked how far I wanted him to go. I replied, "To about 20." He stopped at 22. He counted quickly, easily, and without hesitation. Next, I had him start at 38 and continue until about 50. This, too, was done easily and without hesitation. The last part of this concerned starting at 87. He counted to 109, easily, with only one stop at 100. I told him to go on and he then stopped at 109. This was as high as he could count on his own.

Now came my next task. I felt this would go as smoothly. I asked Glenn if he could count by 2's. He said yes and counted up to 10 easily. Next, I had him start at 10 and count by 2's. "No problem," I thought. He started 10, 12, and stopped. He started over and continued, 10, 12, 14, 17, 20, 23, 26, 28, 30, 31, wait, 30, 33, 36. He vocalized numbers under his breath and moved one hand into another in rhythm. Next, I had him count by 2's starting at 3. By this time, I wasn't so surprised at the results. He counted 3, 6, then repeated, 3, 6, 9, 12, 15, 18, 21. He counted by 3's perfectly, but I was supposed to watch him count by 2's. He at first, seemed to be able to do this. "Maybe," I thought, "he could do this if he started at 2 and continued." I instructed him to do this. Here are the results: 2, 4, 6, 8, 10, 12, pause, 10, 13, 15, 18, 21, 24, 26, 29, 31. He vocalized under his breath again, and moved his hands in rhythm. He began beautifully, but became confused after 12, just as he had previously. Then, he began counting by 3's. After he reached 24, he began counting by 2's, counted by 3's at 26 to 29, and finished by counting by 2's from 29 to 31.

Glenn had probably heard people counting by 2's up to 10 or 12 many times before. This would explain why he was able to do this well. He was not too familiar with counting by 2's after this point. As a result, he displayed rhythmic movements and subvocalization to aid him in counting. Even with this help, he still became confused in certain points. He is not familiar enough with numbers or number processes to complete the task correctly. He probably had never heard anyone count by 2's starting from 3. When given this task, therefore, he probably vocalized what he had heard before, counting by 3's starting at 3. It would have been interesting to see what he would have done if I had asked him to count by 3's starting at 3 after his error. Would he have corrected himself? I'll never know.

CUTTINGS

Ed Rensing

"Teacher Talk- The Failure of Computers in Education?" (see SEEDBED 21)

Yes, I can understand why computers may fail in our schools and become another fad- here today, gone tomorrow. This article expresses my views exactly. The computer purchased for our building (4 for six grades) is a token to display how up-to-date our school system is. But of what value is a TI computer with two pieces of software (elementary multiplication and spelling)?. The TI company has little to offer in software and the district won't (can't?) release funds for expansion on the elementary level.

The teachers were told to jump on the computer bandwagon. We even had an hour-long workshop with hands on experience (2-3 teachers per computer). What a joke. I know nothing about computers and if I don't explore the issue on my own time and at my own expense (one reason for this course), I'll still know nothing.

Right now, all avenues to change are blocked. If parents are really concerned about computer education, I tell them about the problems I have and suggest they purchase one for their homes. I feel that child will obtain more benefits at home than I am now able to offer in my classroom with the resources I have available and the great show of support teachers have from the administrative offices.

CUTTINGS

Doris French

I observed two fifth grade boys using the computer program, puzzle tanks. Both of the boys had had previous computer experience at summer computer camp and in school. Both have computers in their homes and have ventured into some programming on their own.

The boys were anxious to try the program. When the menu first appeared, they quickly selected Level 1 without considering the directions. By trial and error they were able to quickly determine the procedures for working with the program.

Their first attempts on Level 1 were successful. Jeff was running the computer first, but both boys were working the problems. Then Jeff told Clay to do the next problem. Clay hesitated. "How did we do the last one?" Jeff asked him.

"I forgot," said Clay. "I guess it's just subtracting."

The boys noticed after the second problem that the number of tries was recorded. They also commented that the "filling" action was "neat".

After their success on Level 1, they were anxious to go on to Level 2. On the first problem, they decided to deliberately make mistakes to see what would happen. They noticed the tires on the truck going flat.

When the problems first appeared on the screen, the boys studied the possibilities and discussed how to approach a solution. One would ask the other if he could do it.

One problem called for getting 3 gallons from a 4 and 5 tank. Jeff solved it quickly. "Pour 5 into 4; that leaves 1. Do it 3 times and we have it."

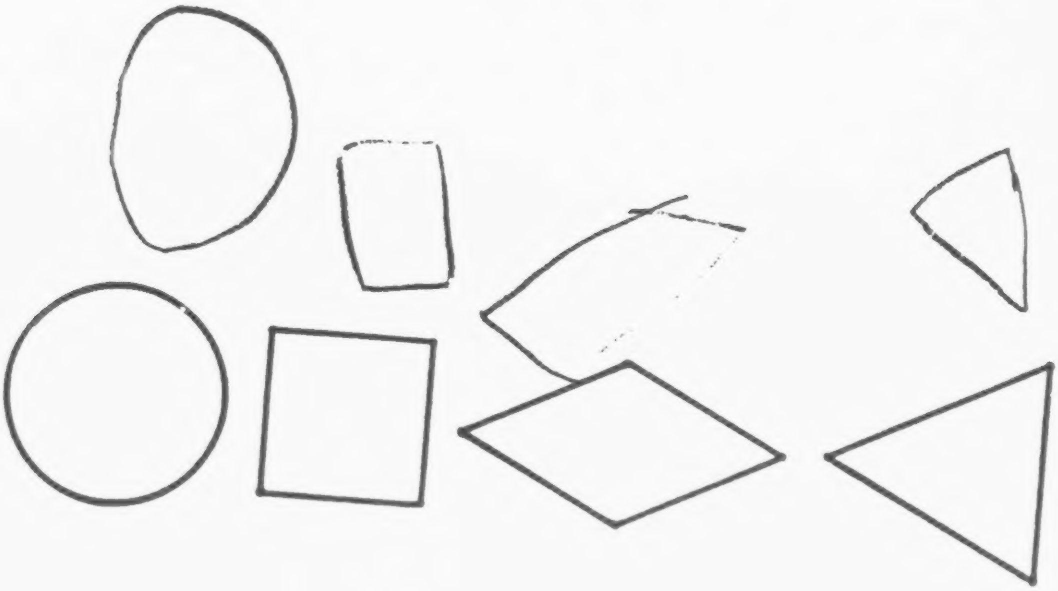
Next, the boys went on to Level 3. The first two problems were impossible, so they just decided to go to the championship level. They solved the first problem in 10 tries and the second one in 6 tries. Jeff was pleased to know that his score was being recorded.

As we started our second session the next day, we discussed the significance of recording the number of tries to solve a problem. The boys decided it would be good to try to improve their scores on some of the problems. Once they took 25 tries the first time, re-ran the problem and did it in 11 tries.

The boys tried to solve a problem where they needed 4 gallons. They had a 3-gallon and a 9-gallon tank. They quickly ran "impossible" and that was correct. I asked if they had a reason for saying "impossible" so quickly. They both agreed that you couldn't get an even number of gallons if both tanks were odd numbers. I then suggested that we watch for this pattern in other problems to see if their conclusion was correct. Later a similar problem appeared. It was not impossible. The boys decided that their rule didn't work.

The boys continued working problems at the championship level. They both succeeded in getting their names and scores recorded as champions. They enjoyed competing against Jeff's scores from the day before.

The total observation experience was a success. The boys were challenged by the program and asked if there were others they could do. I enjoyed watching the boys attack a new learning experience. I watched them interacting, helping each other explore solutions.



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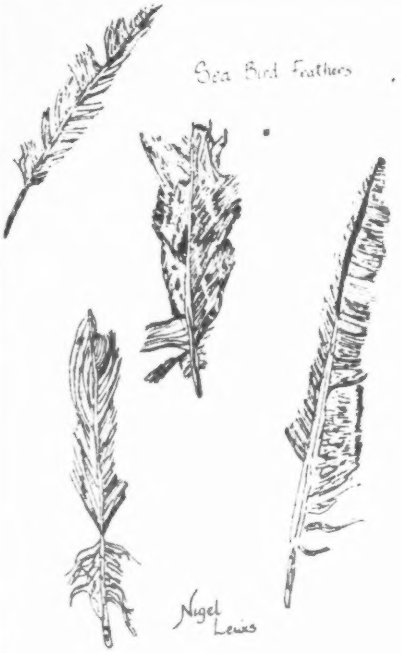

Nigel Lewis age 9

June 18th 1985 Nigel Lewis

The Leaves

1. The Leaves had a wonderful frolic,
The danced to the wind's loud song.
They whirled, and they floated and scampered
They circled and flew along.

2 The man saw the little leves dance.
Each looked like a small brown Bird.
The man in the moon smiled and heard,
And this is the song he heard

3 The north Wind is called is calling.
And we must whirl round and round
And then when our dacing is ended
We'll make a warm quill for the
ground

In the Classroom

When I see my reflection it
is like a ghost is
looking at me
and I am thinking
why is he
looking at me?

The fish tank
bubbling it is like
a fish is popping
them
Some fish are swimming
around, swush swush they go.

Adele Hammerton

Adele Hammerton age 10

The Boiler Room.

I like the fire boiler. It felt like being in on the house with a huge fire but it was only a little fire but it was scorching as any thing because the door was shut. It smelled like rubber burning. It looked like a small oven like my grandma used to have. It looked like a fire that was welding something together.

John Lancaster.

John Lancaster age 11

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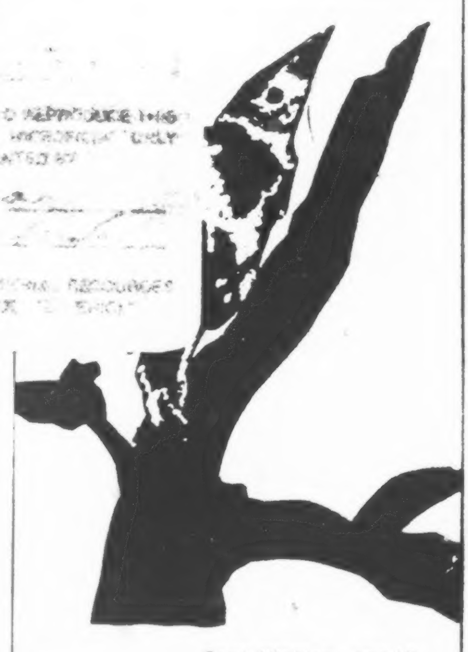

Scott Highton age 10

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SEEDBED

NUMBER 24
JANUARY 1986

Teachers' Center Project

SIUE

Southern Illinois University
at Edwardsville

2491

INTRODUCTION

The story of this SEEDBED goes back to summer 1984 when, with help from the Jessie Smith Noyes Foundation (New York City), the Teachers' Center Project sponsored week-long workshops for math teachers in three sites -- Fullerton CA, Boulder CO, and SIUE.

David Lingard (Head of Northcliffe Comprehensive School, Conisborough, Yorkshire) and Sylvia Johnson (then Head of Maths at Northcliffe, now at Sheffield Polytechnic) conducted those workshops and helped introduce Americans to some of the thinking that guides their work in mathematics education. (An article by David and Sylvia on contrasts between British and American mathematics teaching, which arose from their 1984 visit here, has just been published in the December 1985 issue of Mathematics Teacher. An early draft of the article appeared in SEEDBED 22. The Mathematics Teacher version appears in this issue.)

The sessions were so successful that the Teachers' Center sponsored, in June 1985, a follow-up seminar with David and Sylvia in the schools we had heard so much about. Twelve of us spent a week in Yorkshire schools and this SEEDBED attempts to share some of what we saw.

What we experienced -- and have a difficult time communicating because our dry print doesn't do justice to the richness of what we engaged -- was in many respects beyond anything we had ever seen in terms of educational quality, and caring, and thoughtfulness.

There are several things to bear in mind as you read through this issue of SEEDBED.

1. Although what we saw was in many respects beyond anything we had hoped for, what we saw, we were told, was not the best of what could have been available. During the time we were in Yorkshire, local schools were on a "go-slow," i.e. a mild form of job action in protest of national educational policies. (Perhaps worth noting: teachers' salaries start at US$6500!) Enormous thanks to the British teachers with whom we worked for the gracious and generous reception they gave us in general, and especially under what for them were very trying circumstances!

2. It would not be fair to generalize from our small sample -- our school visits included seven schools -- to British education in general because the schools we visited were chosen by David and Sylvia as among the best in their local area. (It may be interesting to note that all schools we visited were local State schools (i.e. not private (or "public," as the British say)), and most of them were in working class areas in a district of England which has suffered enormous unemployment and economic dislocation in recent years.)

3. Finally, it is dangerous to attempt to adapt British practices to American classrooms. British education is much more organic and much less mechanistic than American education, the climate of caring for children is very different, the underpinnings are much more based upon what is known about children and their thinking and growth, and, after all, plants which thrive in one climate often do not suffer transplant to another.

But it is not at all wrong to think about adapting (NOT adopting) some of the things reported here to one's own classroom or school system in the US. Certainly the caring and the respect given children (and, by administrators, staff) in school situations is susceptible of Americans' attention. And the role of principal (called "head teacher" who routinely teaches classes while acting as educational leader and philosophical guide) and teacher (who devises the curriculum with little reliance on textbooks and commercially produced print material) and pupil (who is much more an agent in his or her learning than is common here) -- all of these are worth serious thought.

"We are not so much interested in preparing children to earn a living." said David Lingard and other head teachers we met, "We are interested in preparing them to LIVE." This we saw in our week's visit -- the latest rich episode in fifteen years of continuing Teachers' Center contact with British maths education. We saw schools teachers and children ALIVE with ideas and with originality and, perhaps best of all, with caring and respect for one another. KIDS COUNT!!! is a message we can well adapt to our local school circumstances.

We are happy to share our experiences with you. By the time you read this, we are likely to be well along in preparation for a second Yorkshire seminar. Summer 1985 was so super we are thinking of mounting a similar seminar with David and Sylvia in June 1986.

Thanks to the very many people who contributed to the success of the Yorkshire seminar. Barbara Goldenhersh, who edited this SEEDBED, says "Thank you" below but it is not out of order here, I hope, to pay enormous thanks to David Lingard and Sylvia Johnson, whose limitless energy, rich ideas, thoughtful planning, and incredible kindness made our seminar a success.

T. C. O'Brien

Thomas C. O'Brien
University City MO

THE SEEDS

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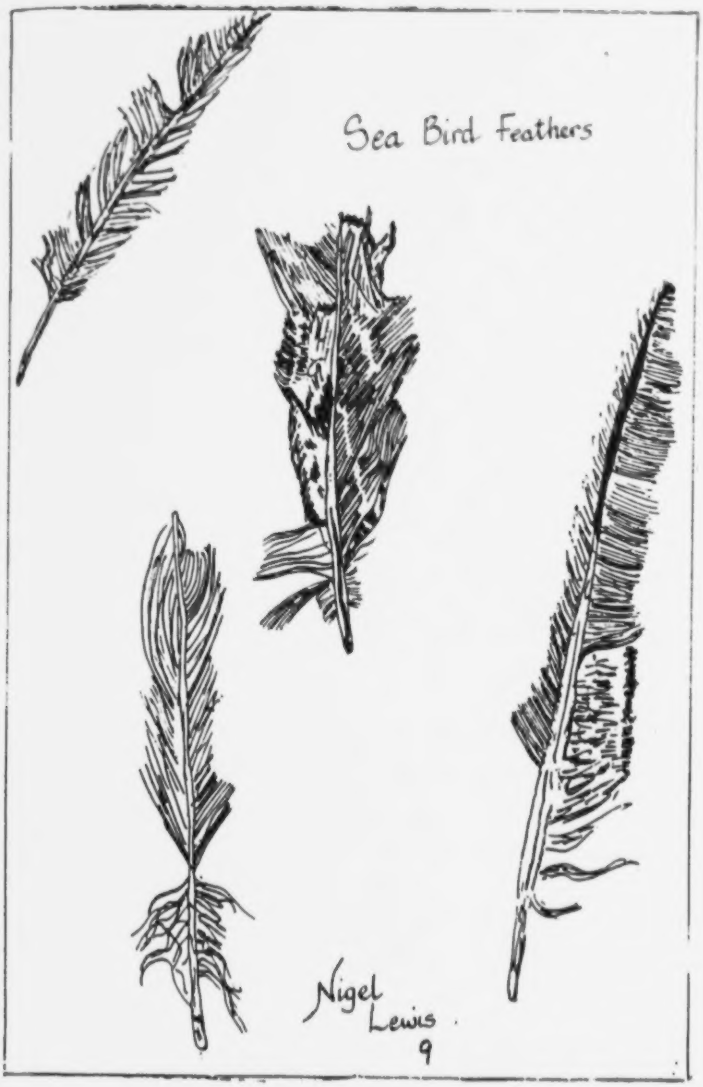
About the Children's Work in SEEDBED

The cover of SEEDBED 24 and the children's work throughout were done by children aged 5-11 at Dalton Foljambe School, Rotherham. The school -- and the philosophy of Head Teacher Philip Woods -- is described in several articles by Barbara Goldenhersh. Suffice to say that Dalton Foljambe's catchment area is "council housing," i.e. welfare tenements, with 70% or higher adult unemployment and the usual accompanying grim conditions, behaviors and statistics. Read Barb's articles then look at the work once again. (The material given to us was by no means the best of children's work. It was the material that happened to be available as the end of the term was drawing near.)

-- T.C. O'Brien



ACKNOWLEDGEMENTS

This issue of Seedbed could not end without expressing our gratitude to the many people who gave of themselves to make our experiences such rich ones.

David Lingard and Sylvia Johnson, organizers, pathfinders, moral boosters, jacks-of-all-trades in making the Sheffield course such a rousing success.

Ted Osborn and Dick Tahta for their wonderful words of educational wisdom on the London leg of our journey.

John Mason and his wonderful family, who took in a group of weary travelers and energized them with mathematics problem solving.

Head Teachers and teachers who opened the doors and hearts of their schools to their visitors.

John Dichmont, David Kirkby, (and again) David Lingard and Sylvia Johnson who gave so much of themselves in the evening seminars.

The Sheffield teachers and families who housed us and allowed us to share the flavor of life in England: Lindy Stone and Ian Curry (and Daniel), Margaret Booth and Alan Brown, Ann and David Thomas, Rosemary and Roger Hubbard, Pam Thorpe, and Sylvia Johnson and David Lingard.

And the children who openly communicated with the folks who "spoke funny" and asked lots of questions.

Barbara Goldenhersh

Barbara Goldenhersh
editor

DALTON FOLJAMBE - A MODEL SCHOOL
Barbara Goldenhersh

Dalton Foljambe is a school in which one finds a level of accomplishment, creativity, and behavior, as well as a sense of self image and caring which would be envied in any school. In viewing the quality of education seen in this environment, it is hard to believe the background of the children attending the school.

Following is a description of the catchment area (local school area) as described by Head Teacher Philip Wood.

> The 260 children (aged 3 - 11) come, almost exclusively from five streets (four of them cul-de-sacs) running parallel, each ending at a very busy main road taking traffic from Rotherham to Doncaster. Some children also live on this main road. The housing is terraced and cramped. The houses are small and most have two or three bedrooms. Each house has a yard at the back and a minute piece of land at the front. The houses are about eighty years old and are owned largely by the local council, to whom the tenants pay rent. There has been a massive improvement scheme taken place on the houses but to visit the streets is to question the use of the money. Streets are strewn with bricks, glass and excrement; dogs roam the paths. Some houses are empty and have been boarded up after windows have been broken. Many such properties have been broken into and had fittings stolen.
>
> Within this area:
>
> 1) over 50% are one parent families.
> 2) over 70% have no adult in full-time employment.
> 3) about 90% of teenagers leaving school have no job.
> 4) nearly 80% of the children have a free school lunch.
> 5) Dalton has the cheapest rents in Rotherham.
>
> Many of the people in Dalton are there because of previous or current domestic problems; many are not extremely intelligent.

I will attempt here to explain some of the very positive aspects observed with the hope that each reader, will find and use some of the ideas encountered to improve their class, their school, their educational environment.

Integrated Curriculum

A major aspect of the English schools I observed is the integrated curriculum. Without rigid departmentalization of "subjects," children can understand the reason for what they are asked to learn and develop their own scheme in which to place new information. Areas of study are based on things real to the children, things which can be shown to them.

Children study their surroundings and come to know and understand much before they are taken into the abstracts of history or the Icelands or Koreas far removed. Field trips in the local area (and afar) are often used to help accomplish this goal. These experiences are followed up in various areas - - math, science, social studies, reading, writing, art. With the interweaving of subject areas, children better understand why they are learning and thus participate in, learn, and retain this more meaningful material.

A class at a level equal to our third grade spent six weeks on a unit on shops (stores). They went to local shops to begin their study. In maths they studied monetary units, percentages, interest, weights and measures and size, as well as basic operations as used in making purchases. In science they learned about scales and balances. Social studies offered a rich selection: consumer awareness, types of shops and their purposes, goods and services as well as workers' lives, working day, and work habits.

Reading involved stories about shops and purchases. Writing was done on all aspects of what they had done and seen. Handwriting was practiced in the copies of the stories they'd written.

Art was accomplished throughout as children drew what they'd seen using a wide variety of media. They made shops from boxes, goods from clay, drew pictures of shops and shop items. These children had done a great deal of art work and were confident in a variety of media and creative in their use. They are not directed in art work ("Draw a Jack-O-Lantern") but create on their own from reality. Since their representation comes from actual objects, they carry pencils, paper and boards on field trips to use on the spot, as they see things. (On touring England, one sees children on field trips drawing at numerous places of interest.)

After the children had been immersed in the present and understood about shops in their own place and time, attention was turned to shops in Victorian times, through a field trip to a Victorian museum. There they saw the same types of shops they had talked about, but from now another era. They could now relate old to new as they had something familiar and understood to which to relate the material. The unit ended with art work and stories about Victorian shops.

In the classroom, text books are available but apparatus and equipment are used to provide activities and experience and to develop understanding.

The integrated curriculum could be easily implemented in our local schools with some simple manipulation of materials now in use. Most social studies texts in the elementary schools offer a unit on a city or country. By replacing this foreign city (which has little relation to the children) with one nearby, one could provide much more fruitful experience. With a little research, a teacher can develop a unit using topics covered in the text. With field trips and the weaving of various curriculum areas into the topic, teachers can enrich vastly what was originally a distant issue largely meaningless to children. Later, studies of things further removed will be more meaningful. For city children, one's own area offers much and should not be ignored. Why study New Zealand when our own city has real meaning (and often remains unexplored)?

The greatest benefit of an integrated curriculum is the children's feeling of ownership. They feel a part of the learning process and feel they are helping to develop it. Their ability to follow their own lead, as in art or writing, to go in investigative depth on areas of particular interest, and to see a reason for the issues at hand allows them to construct relationships, ideas, and skills which will serve them life-long. The school becomes a place not just to mark time. It becomes alive, a place to care about, a place in which to grow and to live.

Creative writing at Dalton Foljambe

E.M. Forster wrote, "How can I know what I think until I see what I say?" This is a view taken to heart in the infant (ages 5, 6 & 7) and junior (ages 8, 9, 10 & 11) schools I visited in England.

Children begin writing their thoughts early in their school experience. Teachers write the children's stories, thoughts or ideas for them and the process of handwriting development is begun. The children "overwrite" and "underwrite," i.e., they trace over the letters, then write just under the letters until they become proficient. This makes handwriting much more meaningful than copying words which are not one's own, while developing the concept of using written words to express ideas.

Throughout the school, every subject area is used as a reason for writing. In maths (a beautiful word for math, since it describes the interrelationship of the many aspects of mathematics and discourages its dissection into separate parts as we tend to do) writing is used to describe how a process was accomplished, why something was done as it was, what hunches and extensions they grew up in the midst of various investigations.

In science, an experiment might be described or a relationship might be explicated by writing (and drawing) about what one has seen and done. In social studies, subject matter is also discussed and developed through writing. As mentioned, subject areas are salted with many field trips and field trips are rich sources for writing.

Language development is a natural outgrowth of the emphasis on creative writing. Placing one's thoughts on paper greatly enhances spoken language. Grammar, sentence structure, spelling, and other such skills are developed as a natural part of the writing process. A wonderful technique for language is the personal dictionary. Each child has a booklet with a page for each letter of the alphabet. When a child asks how to spell a word, it is written in this book. This dictionary is real to these children with more personal importance than a printed book. Eventually, regular dictionaries are made available and children are taught to use them, but not until they find the need to do so.

The work the children do is prominently displayed throughout the building. Every wall inside and outside of classrooms is resplendent with children's writing and art work. Tables are set up in the hallways to hold the items children have created. Books written by the children cover these tables. In short, the school shouts at everyone: THIS PLACE IS FOR CHILDREN.

The level of writing for the total population of the school far surpasses that which we generally see in American schools. The use of writing in all aspects of the school day has developed a creativity throughout the school population that is shockingly rich to American visitors. Writing, in the English schools I visited, is seen as a process, not a product. It is a major part of the process of learning, not just a demonstration of what has been learned and certainly not merely something to be graded for spelling and punctuation. These children learn to use and to trust their own voice and to express their understanding in a way that makes sense to them.

The role of the Head Teacher

The head teacher in the English system is roughly equivalent to our principal. The heads come from the teaching ranks and continue to teach a daily lesson (or more), thus keeping in touch with the children and the materials. The head teachers I observed were continually interacting with children, playing a large part in curriculum development and support of students and teachers. They place the children first, teachers and parents second, and bureaucracy last. Bureaucracy is dealt with after school if and when all aspects of the first two priorities are complete.

The tenor and emphasis of the school is set by the head teacher. At Dalton Foljambe, the head has a small office with a single desk. The secretary uses the phone and desk if it is unoccupied. Otherwise, she has no office. There are no pieces of fancy equipment or other trappings of the typical bureaucratic overlord. There are no copying machines, no ditto or duplicating equipment, but there is a machine which binds children's work into books! The children view the head as a source of encouragement, to share a dream or question with, to find and share pride in their work. The head is not a disciplinarian behind closed doors.

I was told by a number of head teachers that the goal of school is not just to prepare children to make a living but to prepare them to live. What a profound statement! The head teacher sets the tone for the school, and the tone I saw was one of caring for the individual, for the development of each child to the fullest, and for an atmosphere and environment that told each child that he had worth.

The development of self image

Philip Wood, Head Teacher of Dalton Foljambe School, sees school as a society which children must share and care about. In moving toward that goal, he leads a weekly work assembly in which children bring work they've done to share with others.

Each week, half the infant and junior children, age 5 through 11, meet together in the Hall (all purpose room) for this special assembly. Wood calls a class and those with work to share come to the front. He shows the work to all with great enthusiasm, reading the stories, discussing the art work, and asking pertinent questions about the material. Wood uses the opportunity to encourage creativity as he comments on the use of materials: "What a fine idea to use black paper to draw your picture of the lighthouse." Wood brought in the work of some of the 40 nursery children (age three and a half and four) and asked the assembled children to compliment their younger siblings on such fine work. The children of all levels are encouraged to feel pride in their work and the work of others and the assembly's applause for each child is genuine and heartwarming.

In a two week period, every class has the opportunity to participate. Each child has the chance to bring work to the assembly, and over the course of the year every child will have shared a number of times. The variety of age levels encourages the children to know and feel a closeness to children of all ages and keeps the school from being "divided."

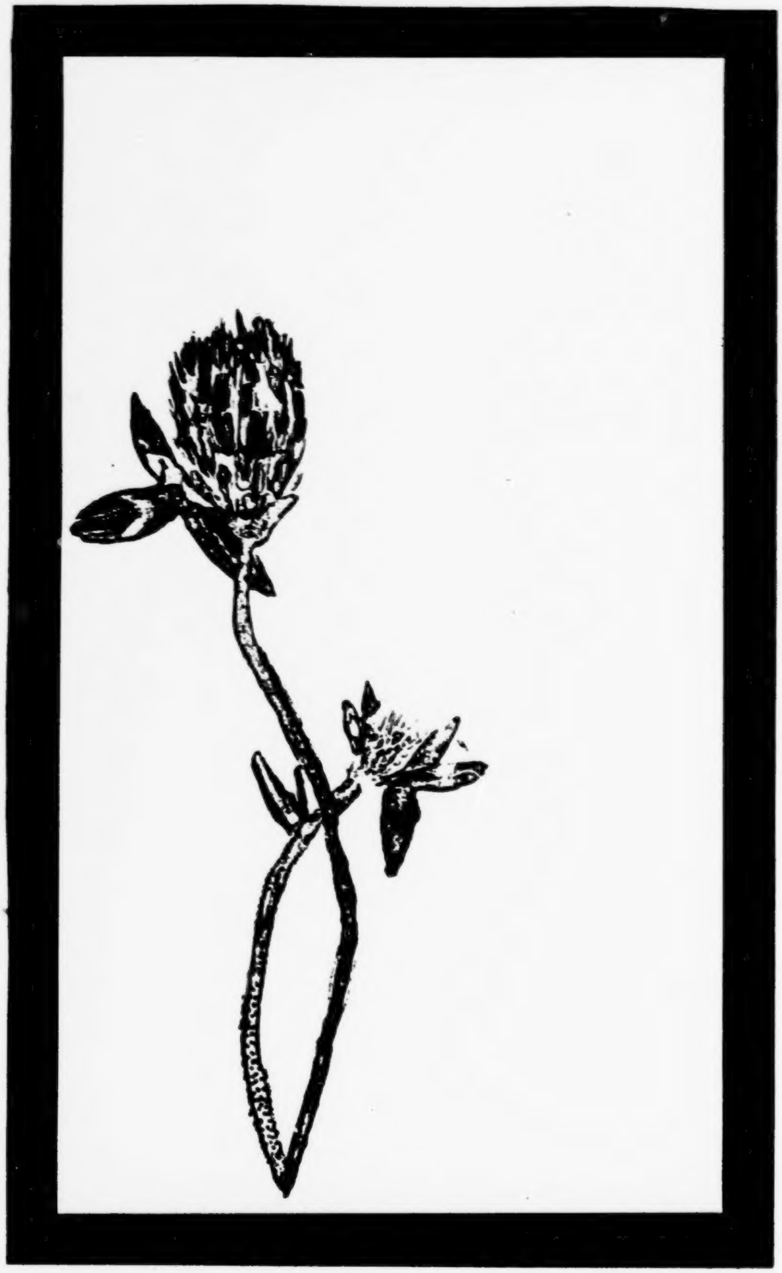
Competition is virtually eliminated as all children are encouraged to feel pride in their accomplishments and to respect and prize those of their classmates. This caring for the work of others seems evident in the positive behavior and wonderful demeanor shown by the children at this assembly and elsewhere in the school.

Additional observations

The behavior of the children in this and other schools I visited in England was exemplary. I have tried to puzzle through the things I saw to develop some understanding of why this is. One aspect seems to be in the lack of pushing. Children move at their own pace, trying not to keep up with their neighbor or with what the textbook or teacher expects but to keep up with their interest - which often moves faster than the teacher might anticipate. This keeps children from feelings of fear and discouragement and thus keeps them from "acting out" in response to negative sensations.

Further, there is more freedom of movement in the classroom with children walking purposefully from one work area to another. Children do not feel the pressure of "Sit down." " Be quiet.", and so there is no adverse reaction when the restrictions are removed. Thus one does not see pushing, hitting, or yelling in the hallways, lunchroom etc.

In short, Dalton Foljambe was FOR CHILDREN. It was a delight to visit.



The Boiler Room

The pipes were like a maze. But they had little silver strips on them. They were going on with some more pipes. The pipes were new one. Some of tham had curvy bits on them. In the boiler room it was very very hot. I was very interested in the pipes because one of the pipes was going on top of the roof which smoke came out of. One of the pipes went where the water was. I bet the water was hot. But one of the pipes looked like a pole that a fireman went down when we went to the fire station. All the pipes went somewhere.

Tina Neale.

PREPARING TO TEACH A TOPIC

John Mason
Nick James
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(John Mason was indirectly a part of the Yorkshire seminar in that half of the travellers stayed overnight at his home en route to Sheffield and he staged, on short notice, a problem seminar for us. An old friend of the Teachers' Center Project, coauthor of "Thinking Mathematically" (Addison Wesley), and a leader in British maths education, John visited the Teachers' Center Project in November 1985, conducted two seminars at SIUE and one in St. Louis, and graciously left this paper with us. The paper originally appeared as a Centre for Mathematics Education informal publication and is reprinted here with the kind permission of John Mason and Nick James.)

You are about to take a series of lessons on Topic X (for example ratio, transformations, place value, ...). Some materials (workcards, texts, equipment,...) already exist in the cupboard, and there is no possibility of obtaining any others. What are the principles you will invoke to prepare your pupils, your lessons, yourself, to achieve confidence in and control of the Topic?

The following response to this challenge outlines in general terms the major principles which have emerged from work in the Centre. Specific examples, in which the principles are applied to particular topics, will be prepared as and when time is available.

General Remarks

I prepare my pupils by establishing a mathematical atmosphere in the classroom in which specialising, generalising, conjecturing, and convincing are expected, supported, and explicitly spoken about. I get them used to coping with being stuck, by getting help from a neighbour before seeking help from me, and by trying to answer the questions "What do I know?" and "What do I want?" for themselves. This training takes place all the time, over the long term, and is not specific to any particular topic.

I prepare myself, by thinking through the various awarenesses that contribute to and compromise my sense of the Topic. No topic is entirely isolated - most are like a nettle that has many long roots linking it to other mathematical ideas. Reviewing the logical connections, the associated imagery, the implicit language patterns and the contexts in which the topic arises, leads me to construct a variety of activities. The activities are intended to provide pupils with the fodder needed to construe Topic X for themselves, with an awareness of language patterns that underlie the Topic, and with a sense of what makes the Topic coherent.

I prepare my lessons with an eye on the data from which pupils will make their own generalisations, articulate those conjectures and modify them, and then move towards recording their Seeings, informally at first, and later more formally.

I try to make sure that there is always something within reach that pupils can confidently do, and that there is a sense of completion or accomplishment every so often.

In more detail, the following questions are addressed, not consecutively, but concomitantly, since the answers interact and inform each other.

The Nettle of Topic X

1. What are the basic components/aspects of the Topic? What is actually involved? What awarenesses are necessary for technical and articulate confidence?

Most mathematical topics grow out from, or draw upon a variety of other mathematical ideas. What are the contexts in which this particular topic arises? What is it that unifies the variety of examples to make this a Topic?

2. What language patterns are relevant to the topic and are already in use by the pupils; needed for mastery; present in some form but open to misunderstanding-understanding?

Most topics have technical vocabulary associated with them. They also have standard patterns of speech which may or may not be readily identified as technical. Pupils come to class with exposure to a wide variety of mathematical and ordinary language. For example, most pupils have heard about "x" long before algebra is introduced for the first time. Since many technical words in mathematics are also used informally in ordinary language, it is important to be on the lookout for possible and potential ambiguities that may lead to confusion. Ambiguity is not bad in itself, indeed it is inescapable, even in mathematics. There are however standard and common quirks of the language which cause unnecessary difficulties.

Most topics can draw upon pupils' experience both in relevant language patterns and in images and awarenesses. Indeed it is often useful to see the purpose of mathematics lessons as to bring to articulation, and ultimately to formal notation, awarenesses that pupils already possess implicitly. Specific techniques and skills are refined along the way, leading to the standard algorithms that are tested in examinations.

3. What automated manipulative skills are already present, or needed for mastery of this topic?

If I am going to draw on previously automated skills, then they must truly be automated or else pupil attention will become trapped by what should be routine tasks. In many topics, the essence of the technique is the deployment of arithmetic skills, so it is worth concentrating on reasons rather than just performance. It is easy to become so absorbed by techniques that pupils can do standard questions but cannot cope with variations.

4. Which activities/problems are most likely to bring pupils into contact with the essential questions and ideas of the topic?

I seek activities/problems which involve, illustrate or invoke the basic idea of Topic X, or which raise typical questions which the techniques of the topic help answer. I seek activities which will engage pupils because there is some element of surprise, something unexpected. The activities I choose will be intended to provide the basis for the generalisations which lie at the heart of the Topic, and which will provide ample opportunity for use and practice of Topic-specific language patterns.

These activities/problems will provide the ground experience from which pupils will generalise the essence of the Topic, so they must contribute to questions of the form "what is the same about...?". Sometimes there is a generic activity which is easily generalised, but most often pupils need to see the same idea in several contexts, and then be invited to look for common features.

5. What typical questions does Topic X address?

Most mathematical "topics" have become identified as such because a technique has been developed for dealing with a range of questions. By studying the Topic, pupils are expected to be able to recognise questions which can be dealt with by the technique, and to apply the technique appropriately. If pupils have no idea what sorts of questions the Topic is intended to answer, they are unlikely to be able to meet either objective!

Taking Enough Time

Selecting some activities for pupils to engage in is just the beginning. I find it helpful to have several triggers to remind me that I cannot do the learning for my pupils, and that they are busy trying to make sense of the activities. I can help them most by providing exposure to a variety of experiences with as much time as possible to become involved, and by maintaining a reflective, inquiring classroom atmosphere. The purpose of obtaining pupil involvement is so that they can reflect on what was going on, thereby construing for themselves what the topic is about. It is all too easy to generate pupil involvement but with no attention paid to the purpose of the activity.

1. Bear in mind See, Experience, Master.

I cannot usually master a new idea on first exposure. I need to "See it go by", and then gradually to come into more and more contact with details. This means continued exposure in a variety of settings.

2. Bear in mind Doing, Talking, Recording / Seeing, Saying, Recording.

It is usually hard to write things down if you cannot say them; it is necessary to see something before you can talk about it articulately; it helps to have done something so that there is something to talk about. Talking about mathematics, in a conjuring atmosphere is a very helpful if not almost essential component of learning mathematics. My job is to provide conditions which are conducive to and supportive of constructive conjecturing and mathematical discussion, allowing time for ideas to be modified and to crystallise.

3. Bear in mind the length of time on a task.

The best activities/problems are capable of extension by pupil and teacher so that pupils can remain engaged in them for long enough to make real contact with the essential ideas and language patterns. Merely "doing" things is not sufficient. Pupil attention usually needs to be directed to "what is the same about...?", or "what is going on...?", in other words to reflect upon what they have been doing, and to tell themselves some story about what it is all about.

Making it Happen

As well as preparing what I shall invite pupils to do, and reminding myself not to rush to formal symbols and definitions, I need to work on how I am going to organise the work. Organisation is partly topic specific, and partly independent of specific topics.

1. Activating Specialising and Generalising.

For example I can start with a problem that is too hard to solve immediately, but which indicates where we are headed. I can then invite/invoke specialising to reach a problem that the pupils can do. By drawing attention to this explicitly I can help pupils become aware of basic processes of mathematical thinking.

I can also start with a simple physical activity, and let the pupils raise questions to work on. By choosing the activity carefully, I can be fairly certain that whatever questions arise will be worthy of study, and if necessary I can guide them towards particular questions.

By constantly drawing on the pupils' already well developed powers of generalising I can help them form their own picture of the Topic. Questions such as "What is the same about ...?", "What if (some aspect) were changed?", or asking pupils to read out their version of the problem emphasising one particular word (the stress thereby inviting consideration of what happens if the word is changed) can help to invoke generalising.

2. Establishing a Conjecturing Atmosphere.

Everything is said with the intention of modifying it. The best time to ask to speak is when you are uncertain, not when you are certain. Being wrong is admirable and respectable, if it takes place in an atmosphere in which people say things with the intention of modifying them.

Inviting pupils to question each other rather than always communicating through me broadens the base of support for pupils when they get stuck. They also learn that the teacher is not the only one to have good ideas, and that they are responsible for deciding if something is correct, not the teacher.

3. Listening.

I find that when I can get two pupils talking to each other sensibly, I am under less tension because I am not responsible for responding. I can therefore listen more acutely and try to work out what the pupils are saying. Training pupils to listen to each other and to work with what others have to say is essential. I can only get pupils to talk effectively with me if I am seen to respect what they have to say. If I want pupils to learn to question, to conjecture, and to try to convince others, then I must also be seen to be acting in the same way, as Questor rather than "know-it-all" teacher.

It is worthwhile developing a variety of strategies for deflecting pupil questions to other pupils so that I am not always the centre of discussion. Sometimes it is important to answer questions directly, but more often it is valuable for other pupils to have a go at answering first.

One good way for pupils to check their understanding of what someone has said, is to try to say it in their own words to a friends or to the class. Teachers very often repeat in their own words what a pupil says, ostensibly in order to clarify it for the class, but actually to sort it out for themselves. Teachers learn a lot this way, but in so doing, take away the opportunity for pupils to reconstruct for themselves.

4. Using Gambits.

A Gambit is a way of organising classroom work, named after the chess gambit in which there is a short term danger but the potential of long term advantage. Thus, getting pupils discussing or working in pairs may seem at first fraught with danger, for they might discuss anything at all without the teacher present. However, having said something to a colleague, pupils are much more likely to be willing to say something to the whole class. The long term advantage will be a more substantial and involved class discussion. Work in pairs can last from 20 seconds to a full lesson depending on the task and topic.

Organising the lesson so that different groups of pupils are working on different tasks, at different degrees of reliance upon the teacher, means that pupils are less likely to need my attention all at once. There is also less pressure on the pupils who work more carefully and slowly.

Each group of 4-6 pupils could have a monitor appointed who is responsible for checking their work, giving an account of their discussion, relaying instructions from the teacher etc. Each pupil can take the role of monitor at some time.

In the midst of exposition, the instruction "In pairs, rehearse what was just said (or what is meant by the term ...)" ..."Any questions?", gives all pupils the opportunity to reconstruct the idea for themselves in their own words. It also gives the teacher a moment's respite.

To introduce a topic to be investigated, begin with an activity, then invite pupils to suggest questions that might be pursued. Having listed these on a blackboard, the class can then decide which questions seem fruitful, and choose which they particularly want to follow. When pupils work on their questions, they have an investment in the outcome.

5. Constructing a Mathematical Classroom Rubric.

Every classroom has its own rubric - the coded or implicit instructions used by the teacher by the pupils. Whenever possible I try to be explicit about these, and to make them as mathematical as possible. For example, whenever I catch myself trying to get the pupils to guess what is in my mind, I admit to them what I am doing, and then tell them what I have in mind.

Specific instructions can be displayed as a poster, reminding pupils that when they get stuck they are to try to answer the questions "What do I want?", and "What do I know?" before bothering others. Then they should try a neighbor, and only then the teacher.

The Role of Mental Imagery

Mathematics takes place mostly in the head, not on paper as many pupils seem to think. The intuitive world of mental pictures, inner speech and body memory is the basis for the mathematics which becomes public.

> What are my mental pictures associated with this topic? Which of them are generic, and which idiosyncratic?

When I become aware of my mental imagery, I can speak directly from that imagery like a tour guide, and thereby invoke imagery in pupils. I can also help pupils become efficient at "Saying what they See" rather than speaking vaguely about what they see. By working for some time just on appropriate mental imagery I can help pupils strengthen the root awarenesses implicit in a topic so that when they become unsure about something, they can go back to the imagery. Inner speech is also a route into forgotten techniques and meanings. There is nothing wrong with chanting of "formulas" if it creates a bed of confidence for the pupils to fall back on in times of difficulty.

These notes are but indicators of domains which deserve attention in the preparing to teach a topic. They are starting points, and by no means exhaustive. No textbook can deal with them for me, because most of my preparation has to do with myself and my pupils. On the other hand a good textbook will suggest appropriate activities and remind me of key awarenesses. If the awarenesses, and the reasons for choosing the activities, are alive inside me, then there is every hope that the topic will come alive for my pupils as well.

OBSERVATIONS AND THOUGHTS ABOUT BRITISH EDUCATION

Ed Rensing

Last June, eleven teachers and I had the opportunity to visit and observe several state (public) schools in the Sheffield area of England. Sheffield is situated in central England--an area heavily industrialized but now suffering 70 percent unemployment. Our purpose was to study the classroom situation in these schools: the curriculum, room arrangement, textbooks, assessment procedures, and the relationships between teacher and students, teacher and administrator, and among the students themselves. The schools I visited were Northcliffe Comprehensive School (a secondary school for students between 11 and 16 years of age) and Concord Middle School (for students between 9 and 13 years of age).

Curriculum

One of the most striking observations I made while visiting these two schools concerned the curriculum. In general, the curriculum is teacher-made and prepared with no dependence upon standard textbooks. Of the three math classes I visited at Northcliffe, the students used teacher-made pamphlets and were progressing at their own pace on their own level. The pamphlets varied from basic arithmetic skills through algebraic and geometric principles.

Each of the students worked independently at his/her table of four students and when the lesson was completed within the pamphlet, the student immediately corrected his/her own work and then had it verified by the teacher. The students were permitted to use calculators and could ask for assistance from fellow students and the teacher.

The teacher did not spend a great deal of time with class instruction or lecture, but rather concentrated upon assisting individual students.

Every few weeks the class and the teacher would spend several class sessions delving into a class investigation seeking a solution to a problem posed either by the teacher or the class. The purpose of these investigations was to apply the mathematical principles already learned and to spark the students into continuing their studies of principles not yet covered, in addition to learning problem-solving tactics, improving thinking skills, and fostering class cooperation and unity.

Another interesting feature of these math classes was the integration of the different branches of math--arithmetic, algebra, and geometry--into one class instead of separate courses for each area. Instead of teaching basic arithmetic skills only in the seventh and eighth grades, algebra only in ninth grade, and geometry only in tenth grade, all areas of math were presented to all students in all grades. It should also be noted that each student progressed at his/her own level when delving into a particular branch of math. In other words, each student was expected to learn algebraic and geometric principles but at different levels of difficulty depending upon his/her ability.

At the Concord Middle School the math classes were arranged according to student ability with the brighter students advancing at a more accelerated rate. In all classes, just as at Northcliffe, the students did not use textbooks but worked from different workbooks and teacher-prepared sheets.

Samples of their mathematical skills (usually related to a project) were attractively displayed throughout the school building. Geometric designs were displayed on many walls, along with detailed scaled maps of the neighborhood and central business district.

It should be noted that the student-drawn maps included streets, buildings, parks, small bodies of water, etc., which the students themselves measured during several of their many field excursions. Accompanying tables and graphs showed the number of automobiles, trucks, buses, and pedestrians crossing at different intersections--apparently the result of a traffic or safety investigation. Journals were kept of these excursions, thus incorporating math, social studies, writing, art and a host of reference skills in one class project. The results by these fifth/sixth grade students were astounding.

In addition to these math classes, I observed a history and geography classes at Northcliffe and a science class at Concord. The history and geography classes involved teacher-student discussion and lecture. In the history class aviation was being studied with the use of many different books and resources. The students drew timelines, researching aviation from its beginnings to the present and sketching the many different types of planes and balloons used for both military and commercial purposes. The geography class was studying a unit on energy and its implications upon the economy of their particular area--an area with many coal mines.

The science class at Concord used a problem-solving approach to teaching. No textbooks were seen but the shelves contained an impressive supply of materials for a hands-on approach to learning. At this time each student was expected to build either a better mouse-trap or a doorbell for a deaf person. Most projects were far from completion, but the amount of thought already put in was astounding.

While visiting Concord Middle School, I was invited to attend a program in which twelve girls (12-13 years old) had volunteered their time during lunch hour for the past semester to teach folk dancing to students at a school for the mentally and physically handicapped. These girls brought something more than dancing skills to this school for the handicapped. They brought love, patience, and understanding to kids who are too often shunned and ignored by the rest of society. To see the happiness and excitement on the faces of these students when the Concord girls danced with them was truly memorable.

To summarize, the curriculum I saw in these schools was teacher-prepared and student oriented. All subject areas were integrated into projects on which the students were working. The atmosphere was relaxed and the students were highly motivated. For these students, school was challenging, enjoyable, and harmonious.

The staff

Collaboration among teachers was highly evident. Teachers worked together to improve the quality of their schools. They shared ideas and offered assistance to fellow teachers.

If a teacher wanted to attend a workshop or lecture during a school day, another member of the staff would readily step in as a substitute. Professional and self-improvement are attributes fostered at these schools. Dedication and pride are evident in teachers' work, conversations, interactions with kids and the hours they keep.

It should be noted that teachers are encouraged to attend continuous in-service training at minimal cost offered by the local education authority. In addition to this training, the local education authority maintains teacher centers providing training staff and a huge assortment of resources to assist teachers in furthering their education.

At Concord Middle School the teachers stay after school for a full hour to discuss the day's events and plan for the next school day. I was told it was not unusual to see teachers working until 6:00 p.m. producing materials suitable for their classes. Often these same teachers socialize together during weekends or holidays to further create a community spirit within the staff and the school.

The same is true at Northcliffe. Often an entire department would meet to create new materials, discuss problems, assess students' progress, or seek ways of improving both the quality of their teaching and their curriculum.

The head teacher (principal) at both schools spends more time teaching than administrating and most of the administrating centers upon staff and curriculum development, not budgets, discipline, or building maintenance. The head teacher, as all teachers, knows the names of most students and is genuinely concerned about the progress of each child.

To summarize, the staff is highly motivated to provide the best education for each individual student. They work together as a group and often seek guidance from each other. In-service training is readily available for further improvement.

Assessment

The only major testing brought to my attention was the certificate of Secondary Education administered at the end of the tenth grade. These tests are teacher controlled; that is, the teachers create and administer their own assessment tests.

It must be noted that these tests are not multiple-choice tests. The questions demand answers which reveal a student's problem-solving, writing, and mathematical skills. (See sample questions from the Final Examination Paper for Geography). The assessment of these tests is not the final answer but rather the procedures, the processes, and the methods employed by the student to reach a solution. Quite possibly, the problem being tackled could have several different solutions or perhaps no solution at all.

My observations of these two British schools are too brief to make thorough going conclusions. I do know that their methods of teaching are much more personal and the results, as far as I have seen, should make American educators stand up and take notice.

3 Fig. 2 shows the position of Knob Lake and Fig. 3 gives information about the precipitation and runoff in the Knob Lake catchment area of North-Eastern Canada.

(*a*) Explain *each* of the following statements based on the information in Fig. 3.

(i) In May and June 1964–65 runoff actually exceeded precipitation.

(ii) Runoff was at its lowest in the four months from January to April.

(iii) The wettest months were July and August but they did not have the greatest runoff.

[3, 3, 3]

(*b*) Suggest possible reasons why in 1957 a smaller proportion of the total precipitation became runoff than in 1964–65 or 1962. [6]

(*c*) Describe, referring to examples where possible, how variations from season to season in runoff in drainage basins may influence human activity. [10]

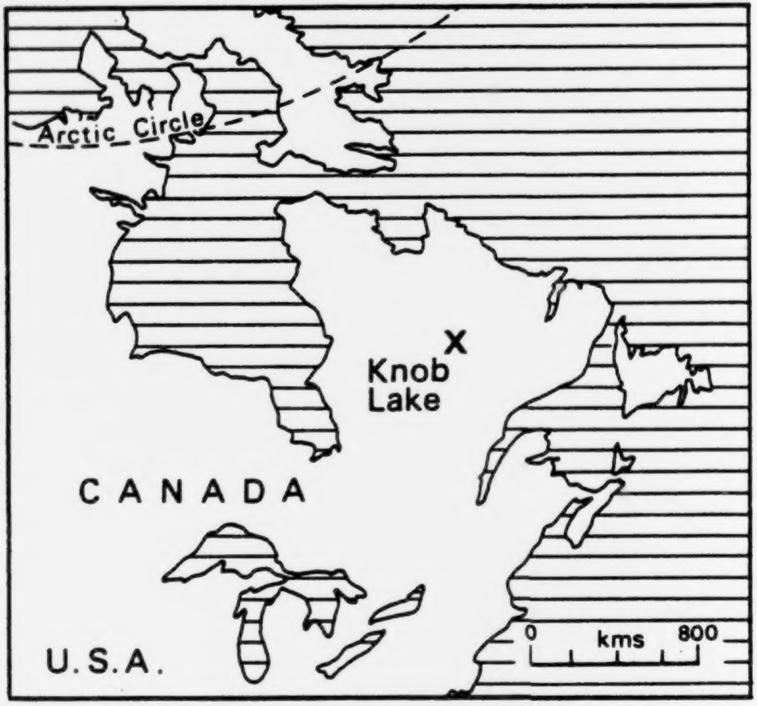


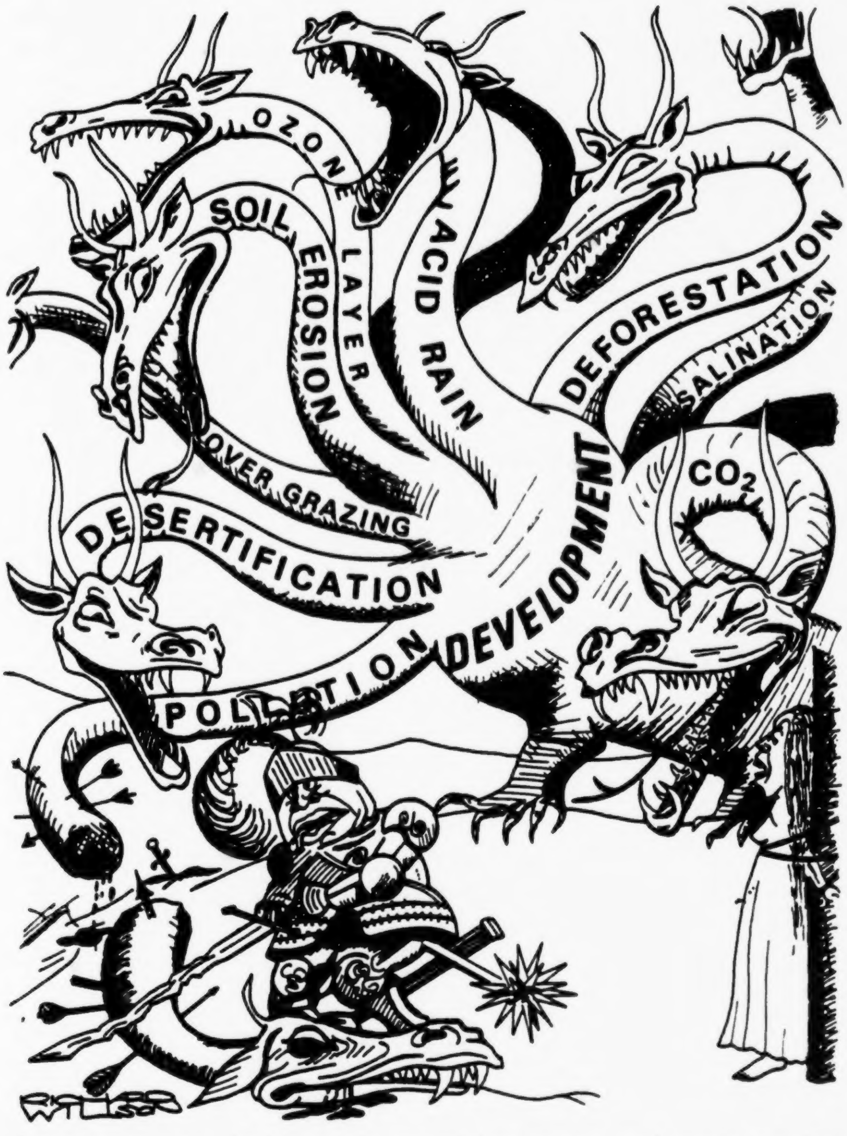
Fig. 2

4 The cartoon in Fig. 4 compares attempts to conserve the environment with St. George fighting a many-headed dragon.

(*a*) Explain the princess's comment to St. George. Do you agree with her? [6]

(*b*) Despite the fact that environmental threats, such as those represented by the dragon's heads, are well known, they are an ever-increasing problem in many parts of the world. Choose **two** of the threats and explain with examples, if possible, why this is so. [10]

(*c*) For a location or area you are familiar with, describe what steps have been taken to conserve resources and the environment. [9]


OZONE LAYER
SOIL EROSION
ACID RAIN
DEFORESTATION
SALINATION
OVER GRAZING
DESERTIFICATION
CO_2
DEVELOPMENT
POLLUTION

Don't you see, he'll go on sprouting more and more heads. It's the body itself you must go for. The Ecologist.

Fig. 4

6 Fig. 6 shows the transfer of agricultural land to other uses between 1931 and 1980 in England and Wales.

(*a*) According to the graph, what was the main trend in the amount of land used for agriculture between 1931 and 1980? [4]

(*b*) Describe and suggest reasons for the transfer of agricultural land to and from government departments shown by the graph. [4]

(*c*) Compare the amount of land lost in 1931–35 to urban, industrial and recreational developments with that lost in 1976–80 and explain the differences you find. [7]

(*d*) In spite of losses of agricultural land to other uses, the agricultural industry is now more productive in Britain than ever before. Explain why this is so. [10]

TRANSFERS OF AGRICULTURAL LAND IN ENGLAND & WALES TO URBAN AND OTHER USES IN EACH 5 YEAR PERIOD 1931 - 1980

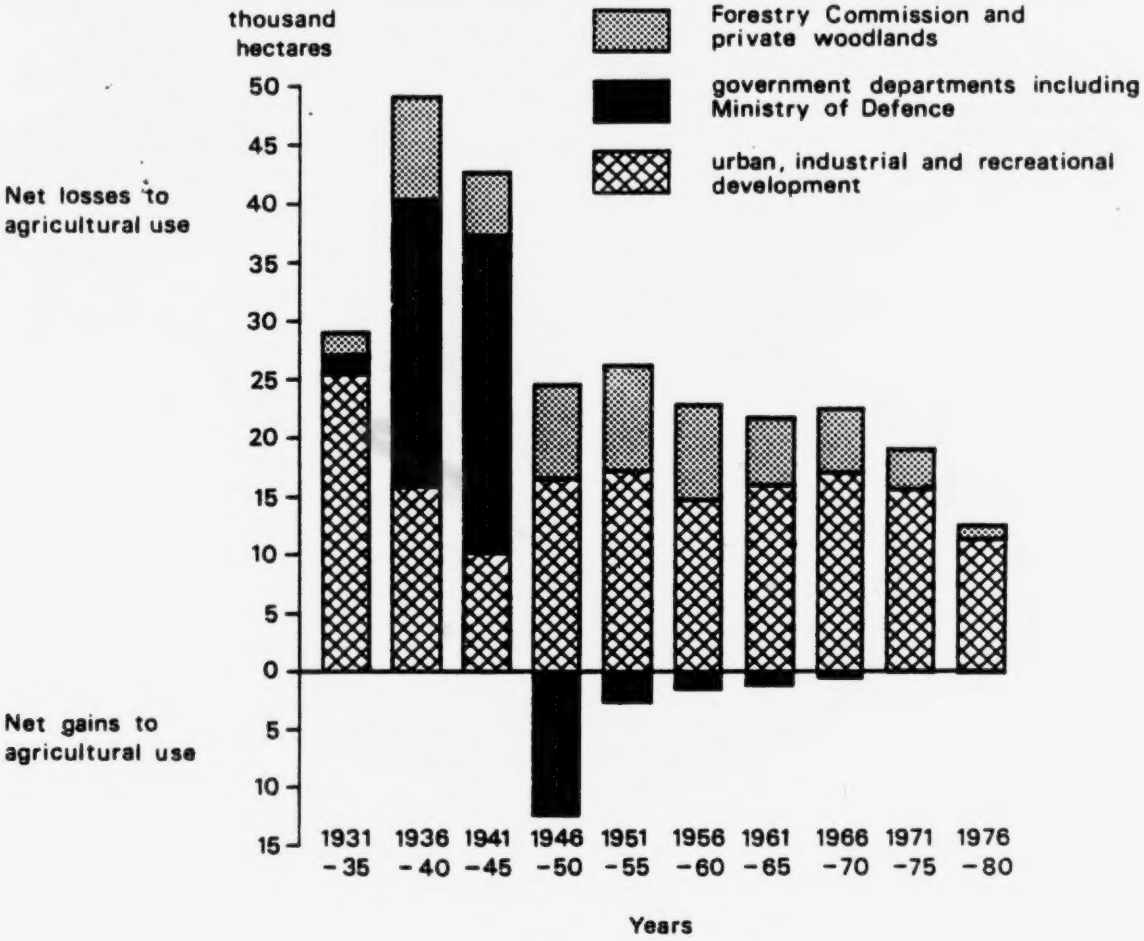


Fig. 6

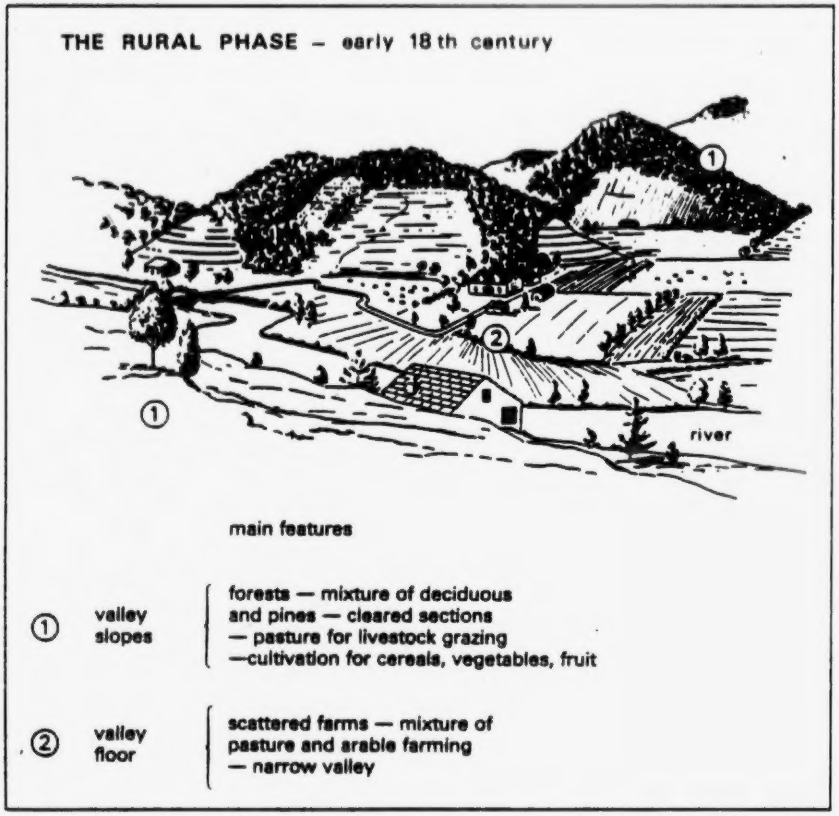
2519

7 Fig. 7 (pages 10 and 11) shows how the landscape of many valleys in Western Europe and North America has changed as a result of the exploitation of local mineral resources for heavy industry.

(*a*) **Either** write a description or complete the sketch outline provided (Fig. 8, Inset 1) to show how you think the landscape might look today. Explain the changes you include. [8]

(*b*) There are many ways in which this scene could change by the year 2000. Describe **one** of these alternative features, giving reasons for the changes. [8]

(*c*) Name an area with which you are familiar and explain briefly how its landscape has changed since the early twentieth century. [9]

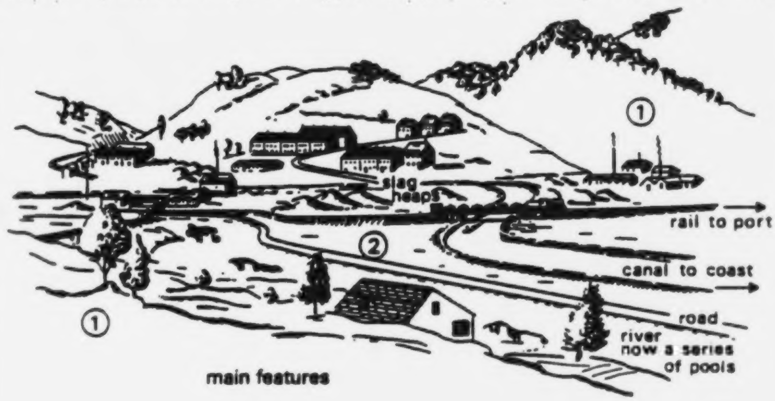

THE RURAL PHASE – early 18th century
①
②
①
river

main features

①	valley slopes	forests — mixture of deciduous and pines — cleared sections — pasture for livestock grazing —cultivation for cereals, vegetables, fruit
②	valley floor	scattered farms — mixture of pasture and arable farming — narrow valley

Fig. 7 (continued on page 11)

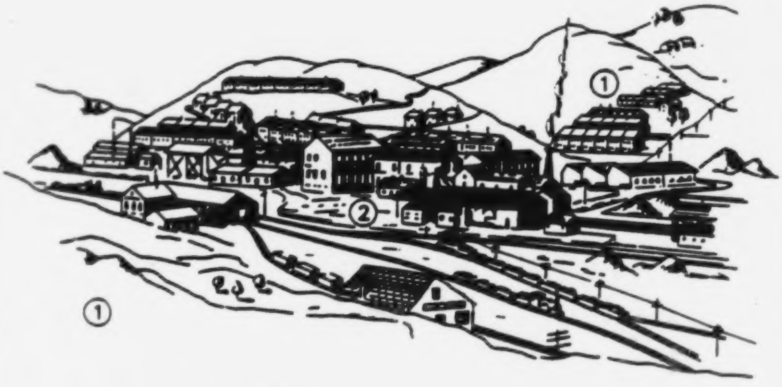
THE EARLY INDUSTRIAL PHASE — early 19th century



main features

①	valley slopes	most of the trees removed for industrial fuel — limited pasture remains — arable (terraced) land taken up for workers' homes — roads penetrate hillslopes
②	valley floor	considerable alteration — iron foundries and communication networks — river diverted and used for industries and canal

THE HEAVY INDUSTRIAL PHASE — early 20th century



main features

①	valley slopes	row houses — urban development — location of industrial waste tips
②	valley floor	heavy industry — iron and steel smelters — river entirely controlled upstream — valley floor now packed with buildings and communication networks

Fig. 7 (continued from page 10)

9 **Table 1 compares the types of neighbourhood in Liverpool using certain "indicators of deprivation".**

Table 1

Deprivation in Liverpool, 1971 (as % of the average for the city as a whole)

Indicators of deprivation	*Neighbourhood type*				
	High status	*Divided housing, lodgings, bedsits and flats*	*Inner city council estates*	*Outer city council estates*	*Older terraced houses*
Long-term unemployment	32	136	250	102	89
Youth unemployment	33	110	199	145	63
Youth job instability	17	151	302	112	68
Free school meals	29	81	201	147	74
Higher Education Grants	225	123	32	67	54
Infant mortality	75	157	158	69	118
Infectious diseases	68	167	143	82	110
Repair notices	52	191	58	22	215
Disinfestation orders	58	82	265	84	104
Car ownership	189	105	20	81	77
Shared dwellings	76	508	57	35	75
Ill-equipped dwellings	70	119	74	77	153
Overcrowding	16	170	363	101	55
Single-parent families with 2 or more children	27	118	230	117	89

(*a*) In which parts of British cities would you expect to find the following:

(i) high status neighbourhoods,

(ii) neighbourhoods with divided housing (bedsits and flats),

(iii) old terraced neighbourhoods?

[6]

(*b*) **Either** Compare the conditions and problems, suggested by Table 1, which the residents of inner-city council estates and outer-city council estates have to face.

Or Suggest reasons for differences between the five types of neighbourhood mentioned in Table 1 in:

(i) long-term unemployment,

(ii) car ownership,

(iii) ill-equipped dwellings,

(iv) overcrowding.

[12]

(*c*) Outline steps which could be taken to help the residents of the more deprived neighbourhoods to enjoy a better quality of life. [7]

11 (*a*) Figs. 12A and 12B show the distribution of unemployment in the United Kingdom by the eleven "standard regions" in 1979 and 1983.

(i) Use the maps to compare changes in unemployment in the South-East region with those in Northern Ireland between 1979 and 1983. [6]

(ii) A line drawn from the Severn to the Humber is said to divide the United Kingdom into two nations. Does evidence on the maps support this view? [6]

(*b*) A British geographer, Peter Hall, writing about the future geography of the United Kingdom has made the following statements.

(i) "Tomorrow's industries are not going to be born in yesterday's regions."

(ii) "Britain's future, if it has one, is in that broad belt that runs from Oxford and Winchester through the Thames valley and Milton Keynes to Cambridge."

(iii) "The aim of government should be to start planning for a massive move of people from old areas and cities to the new."

Choose **one** of these statements and suggest why Peter Hall takes this view. Say whether or not you agree with him and suggest arguments against his point of view. [13]

REGIONAL DISTRIBUTION OF UNEMPLOYMENT IN THE U.K. 1979 & 1983

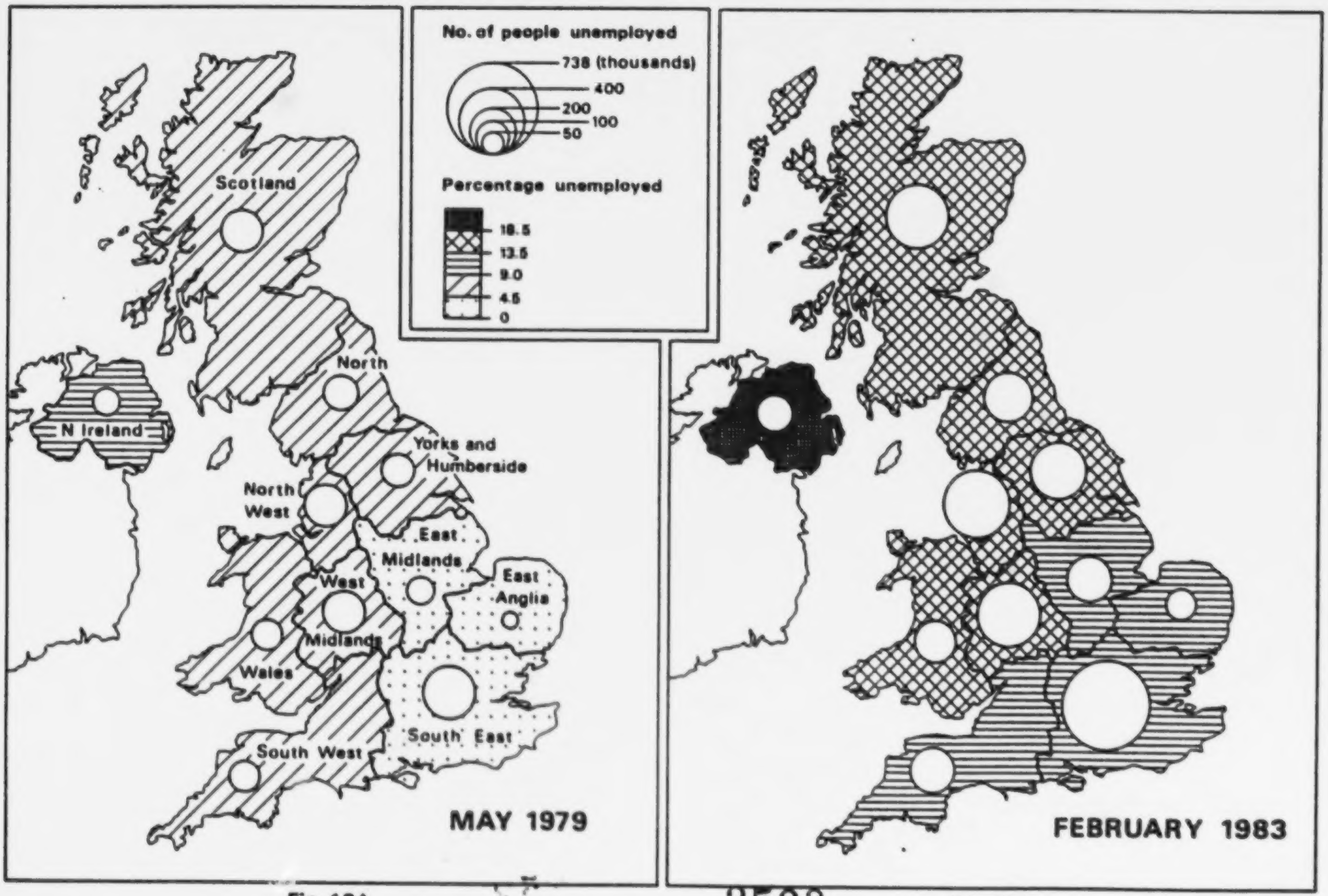

No. of people unemployed
738 (thousands)
400
200
100
50
Percentage unemployed
18.5
13.5
9.0
4.5
0
Scotland
North
N Ireland
Yorks and Humberside
North West
East Midlands
East Anglia
West Midlands
Wales
South East
South West
MAY 1979
FEBRUARY 1983

Fig. 12A

Fig. 12B

AN INVESTIGATION PROBLEM IN A MATHS CLASS

Judy Barnett

What is an investigation problem? And what is a maths class? These are questions I immediately faced in Sheffield, England, as I listened to the teachers trying to explain what they do.

First, the two secondary schools I observed both called the subject maths, not math. They do not teach algebra, geometry, calculus, trigonometry, or some of the other topics as separate units. They teach maths and these are all interwoven. Next, in their maths programs they periodically use a method called investigation. I'll come back to this, but first some background is needed.

The children in the first three years follow a common curriculum with most classes made up of mixed ability groups. This coincides with our sixth, seventh, and eighth grades. Their next two levels are blocked according to ability. Only about 10 percent of these students will go on to college. (University education is tuition-free.)

The setting in these maths classes was interesting. In every class I observed the students were allowed to choose their own seat. The seating arrangements were usually tables placed in a U shape or in random pattern. There were about twenty students in a class.

Frequently the students worked out of individualized booklets. They all worked at their own level and yet were allowed to draw help from any other student in the class. The problems were all word problems in the sense that they were posed in sentences. They were not word problems in an American sense (disguised computation) but consisted of graphing, gathering data, finding relationships, etc. Students were encouraged to find the answers by any method they chose with no "one right way" taught. Much of the time I observed students trying to work out problems in their heads rather than using scratch paper. Calculators, tables, and manipulatives were allowed most of the time. Upon finishing a lesson, students would grade their own work and then show it to the teacher, if all correct. If mistakes were found, the student would return and redo the ones missed. I saw this kind of lesson repeatedly in both schools and was impressed with the relaxed, positive atmosphere.

It was in an eighth grade age group that I observed my first investigation class. The students were given a handout called an investigation with squares and a work sheet. Here is a copy of each.

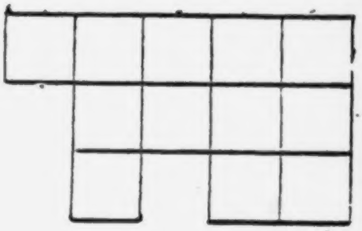
3rd year Friday. 14th June

AN INVESTIGATION with SQUARES.

Remember: Show all your working clearly, so that someone else can follow what you did.

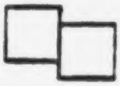
Suppose you have 12 squares, each 1 cm by 1 cm.
There are many different ways to arrange them edge to edge on a flat table.

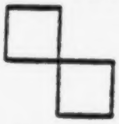
Here is one arrangement of the 12 squares.
Its perimeter (the distance all round the edge) is 18 cm.



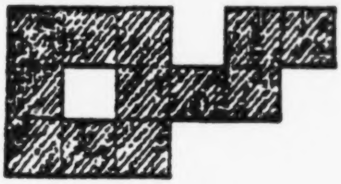
1. (a). There are some more arrangements of 12 squares on the worksheet. Under each one write down its perimeter.

(b). On the worksheet, draw another arrangement of the 12 squares whose perimeter is 16 cm.

Squares are not allowed to 'overlap', like this 

Squares must touch edge to edge. Touching only at corners, like like this  , is not allowed.

There must be no 'holes' in the arrangement.
So this, for example, is not allowed.

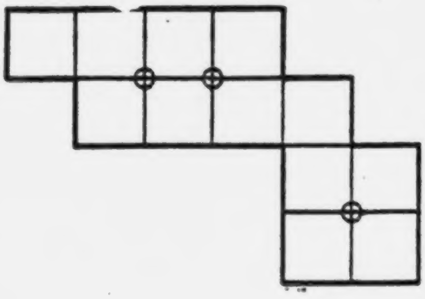


(c). As in (b), but this time make the perimeter 20 cm.

2.

Here is one arrangement.
In this arrangement there are 3 points where four squares meet together (marked with circles).

The perimeter of this arrangement (the distance all round the edge) is 20 cm.



Investigate other arrangements of the 12 squares and see if you can find a connection between the number of points where four squares meet together, and the perimeter.

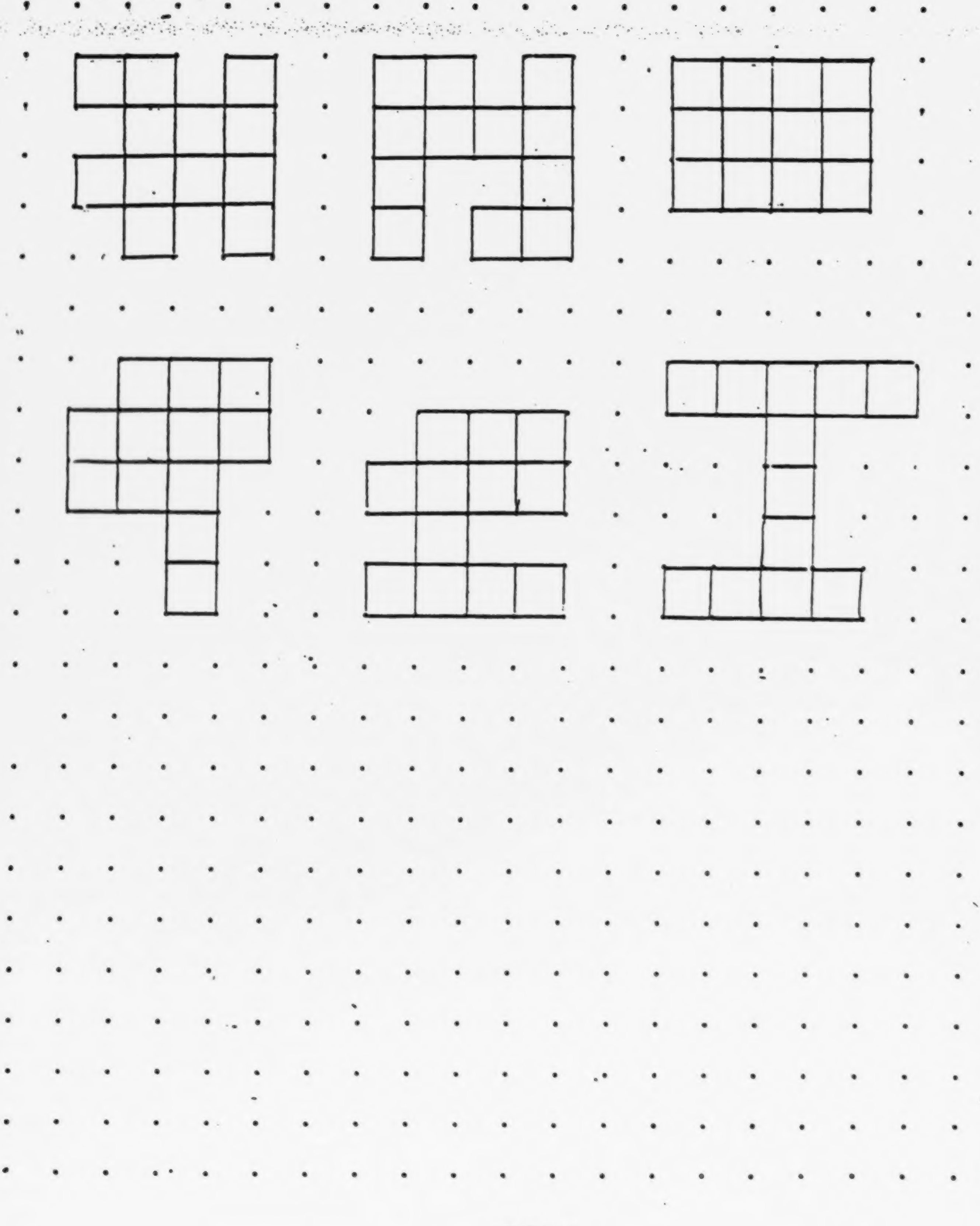
Remember:

(1) Describe how you tackle this investigation, so that someone else can follow what you did.

(2) Answers by themselves are not enough. You must show the working that leads to them.

3. If you can find a connection between the number of points where four squares meet and the perimeter, then try this again using only 10 squares (instead of 12), and see if you can find a connection this time -- between the number of points whose four squares meet and the perimeter.

Worksheet



The students had started this project a previous day and were working on it for a second period. Most had drawn many 12 block arrangements. The teacher gave a few instructions at the beginning of the class and stressed the importance of the chart they were to make, organizing the results of their drawings.

He drew this on the board as an example.

Diagram	Perimeter	Four Squares
A	24	1

The students went to work and the teacher circulated, interacting with each student and questioning their findings. I asked several students if they had any idea what they were going to discover. At first none did but then some started to see a pattern. After awhile the teacher asked for attention and started filling in the chart on the board with information given him from the students' findings. Then he asked for theories and he listed them on the board. Here are some of them.
Student: "All perimeters are even numbers."
Teacher: "Why?"
Student: "There are 12 squares and 12 is even."
Teacher: "How could you test that?"
Student: "Try 13 squares."
The class each worked a separate problem with 13 squares. All answers came up even.
Teacher: "Why is the perimeter always even?"
There was no answer.
Teacher: "Think about it."
Student: "The bigger the perimeter? the smaller the number of centers and vice versa.
Teacher: "Can you draw any with a perimeter larger than 26? And what is the smallest possible perimeter."

The students eagerly went back to work trying to solve these problems. The class time ran out.

During this class I observed the teacher challenging quicker students with endless questions and continued research problems and keeping the middle range and slower students discovering at different rates. It was fascinating. Then in another investigation class, I saw a teacher introduce a challenging, open-ended problem and then ignore his class to the point that it became restless and somewhat unproductive.

Still another teacher gave me a definition of what he was trying to do with the program. He said the booklet work was not truly investigative but it does teach thinking and problem solving. The booklets had been teacher tested by the teachers in their building. He also believes in doing what he calls "mental arithmetic" about once a week. The classic example he gave me was - Take the number of windows in the room, multiply them by the number of legs in the room, divide by the number of tables, and then multiply by 0. What's the answer?

Some of the goals of the investigation method used here are to start out with something concrete, understand the concrete, then move toward the abstract. The students should be able to verbalize what is happening and communicate these answers to the other students and to the teacher. They are encouraged to help each other in any of these processes.

When I found out I was going to England to visit schools, the thing I wanted to see most was how to deal with an open-ended problem situation with no one right answer, the type that might lead in numerous directions. I was lucky to see this done expertly by several teachers. Their questioning skills were critically important in achieving success in these classes. The thing that amazes me most was the teachers' ability to keep all students challenged and give the faster student more of the same kind of problems to keep them busy while other students try to catch up. The critical element in these classes is the same in England as it is here. A method is only as good as the individual teacher using it. You need involvement, enthusiasm, and questing skills for the investigation method to achieve satisfying results.

LEARNING THE LANGUAGE OF MATHEMATICS

Pat Lawrence

In what ways can we help children develop fluency in the LANGUAGE of mathematics? Teach them to verbalize everything they can discover and remember about numbers.

This may seem too simple to most elementary teachers, but to me the process was amazing. I had always imagined that children were born counting and picked up the other quantity-vocabulary by squabbling with siblings over treats, and I couldn′t figure out why they had forgotten it all by junior high!

It was clear to me that the British children I watched work had indeed had many concrete experiences with number, from counting pennies for biscuits to lining up and counting off by twos and threes. Everything in their rooms contributed to learning patterns and relationships.

Then, at appropriate times, the connecting and symbolic levels of learning were followed by abstraction of patterns and development of the language involved. Here is an example of this I observed in a directed lesson with the Third form in Infant School (ages 7-8, our second or third graders,). It was right after lunch, but all were at full attention, there were no sleepies.

a) As students name digits the teacher writes on the board:
0 1 2 3 4 ⑤ 6 7 8 9 10, then circles the 5.

b) Teacher: "Who can tell something about this?"
Many hands go up. Teacher elicits comments, repeats each, reinforces with visual gestures, gives recognition to contributor, gets more comments;

"You circled the five." -- circling motion repeated;

c) T: "what do we know about 5?"

"Five is half ten" -- points to end, mid-point, end.
"Five needs three more to be eight." -- covers group 1-5 then shows that 1-2-3 more reach to 8.
Several more: five needs ___ more to be ___.

"Zero is five less than five." -- starts at five and counts back
Several more: " ___ is ___ less than five."

"Five is odd" or, "...not even."

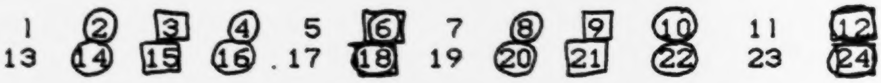
d) T: "Stop." That's quite a bit of mileage out of five!

e) Next, teacher writes out a number line, 1 to 24, then with green chalk circles $\boxed{3}$, 6, 9 ... "Now what have I done?"

Some attempts at describing multiples; (I wish I had written those comments in my notes!) Then teacher helps out, "We say 'circled those we count by threes'."

"Let's say them: 3, 6, 9, 12, .. 24," while pointing.

Now with pink chalk the teacher circles (boxes) the multiples of 2.



Again "What have I done?" This time the ready response is, "You circled those we count by twos." --recite those.

f) Here comes the really meaty investigation of patterns:

T: Calling attention to the six, which has both green and pink (my circle and box), teacher asks, "What can we say about 6?" This is harder to elicit.

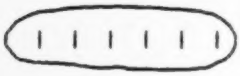
Student: "It's in with the 2's and the 3's.

T: "Yes, it's an intersection where the 2's and 3's meet." Anything else?' (Long pause)

T: Teacher draws six lines and asks how they can be shared.

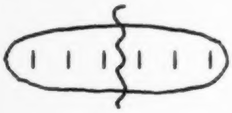
S: "One can have the whole lot." Teacher circles all six.

S: "Six can each have one."



Good grief, they're factoring!

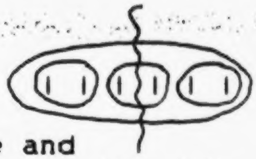
Next, a line is drawn to split the circle, with a brief aside about partitioning and semi-circles.



S: "Oh, two can have lots of 3."

T: "Let's concentrate on this. Can anyone see another way to share six?" wait... and wait ...

S: "I see three lots of two!" --reward.



(The expression 'lots' is very comfortable and eloquent; it seems more literary, somewhere between 'bunch' and 'set'. I must remember to use it.)

After about 25 minutes of intense concentration, the lesson closes with a quick listing of terms used. Included were: more than and less than, lots of __, count by __, intersection, semi-circle, partitioning. "Now we have these to use in our maths writing. You may put them in your workbooks."

These children keep a blue-book type journal which includes full-sentence answers to questions from the math cards (activities, investigations) and from the circulated few scheme books (textbooks). Their journals have copies of class-made bar graphs with sentences giving their own interpretations.

They are learning to think mathematically and to talk and write about their findings. That's quite a LOT!

In The Classroom

When I see my reflection it
is like a ghost is
looking at me
and I am thinking
why is he
looking at me?

The fish tank
bubbling it is like
a fish is popping
them
Some fish are swimming

around, swush swush they go.

Adele Hammerton
10

THE ROLE OF THE HEAD TEACHER

Sandy Kinder

It was interesting to see the role of the head teacher in action in the two elementary schools where I observed. The head teacher is a former teacher who has, in most cases, proven to be a master teacher. That is... they are usually appointed "head" on the basis of educational excellence. In the schools we visited, the role of the head teacher was paramount in establishing and guiding the school's philosophy.

In one school, the head teacher gave us a hand-out entitled "22 Propositions" (reprinted in full in this SEEDBED). His staff seemed to work as a team to make the propositions a reality. The head teacher said he treated his staff like he wanted his staff to treat their pupils! This became quite apparent when we were invited to listen in on a faculty meeting. First of all, it was conducted by one of the teachers instead of the head teacher. (I think they took turns.) The atmosphere was relaxed and some teachers, including the head teacher, were seated on the floor. The teachers had an agenda and there was much interaction. At no time did the head teacher assume an authoritarian role. The group discussed issues, made decisions and postponed others, and even brainstormed to come up with ideas and suggestions. The teachers treated each other with respect, and the head teacher treated the teachers with respect. Teachers' opinions and feelings mattered in that school!

In another school, we had the opportunity to follow the head teacher around as he performed his duties throughout the day. We spent most of the morning discussing the school's program and were interrupted often by parents, children, the secretary, and teachers. Their needs came first. The head teacher took the time to answer their questions or help them with whatever they needed and then we went back to our discussion.

This head teacher taught classes on a regular basis. He was strong in the area of math (maths), so he not only taught some of the math classes but also had a table in the hall with math puzzles and activities for the children to solve in their free time. We watched him teaching a math class of 9-10 year olds in which the children used a pegboard-like piece of math apparatus. He showed the class how to place colored pegs into the board to make squares. They discussed how the rows going across and columns going down had to have the same number or else the figure wouldn't be a square. Someone drew a 4 by 4 square. How could they write this? Someone said 4x4=16. Another said 4+4+4+4=16. Then the head teacher introduced the notation ^{4}. The children wrote the powers of the other squares they had made with the pegs. They all seemed to catch onto this method of representing the squares they could visualize on their pegboards.

We then followed the head to the multi-purpose room where he taught a class in body movement. He said that if a teacher felt weak or uncomfortable in a subject or if they needed a planning period, he would teach their class. At the other school we visited, the head also taught a class while a teacher attended a meeting, so I'm assuming it was common practice to see the head teacher teaching.

The head teacher then took us to the daily assembly. As the children filed into the room, we could hear music being played by students. The school band played recorders and the music wafted through the halls with a magical lilt. The head teacher read a story written by one of the students. He praised the child and his work. He showed the group pictures that students had drawn and complimented them on their accomplishments. (He really made a big deal over each piece of work.) He announced that nobody had solved one of his math puzzles in the hall, and he encouraged anyone who hadn't tried it to see if they could solve it. He then announced who had solved some of his other problems.

The children sang a religious song and prayed during the assembly. Religious education (Church of England) is mandatory in schools but with an increasingly multi-ethnic school population in England, religious education is being re-thought. Having the song and the prayer as part of an assembly where the children received so much praise and attention for work well done seemed to be very motivating for the students.

During that day, the head had a meeting with a group of parents who had wanted to have a pub crawl (meaning that they wanted to go from pub to pub) to raise money for the school. He said it was hard to get parent help at this school so he didn't want to discourage their enthusiasm but having a pub crawl wasn't the usual way to earn money for the school. He had told them no, but they had said they were going to do it anyway. He was meeting with them that day to tell them that if they decided to go ahead, at least they should get a permit which he had discovered they would need.

June 6th

The Fight

It all started when me and my friends were messing about on the phone, phoning the operator and getting free phone calls and my friends kept having more goes than me so I said to Claire Cox 'give me a go' I said 'comeon' she said 'no' I said 'comeon because if you dont I'll smack you' she said 'comeon you start comeon you chicken' so I did and she pushed me out of the telephone box and and when I started to fight my heart was thumping about 100 times a minute and I could not stand on my two feet they were like jelly. Then Claire's brother came on his B.M.X and started to cheer comeon claire smack her head in. noone was cheering for me I was feeling left out. Then my brother was coming down the hill but I kept on fighting because my best-friend was there and she thought that I was tough and I did not want to get shown up so I tried to win at that time I had sharp nails and she pulled my hair so I scratched all her neck and it was bleeding. Then my brother split it up there was no damage done to me. My brother took me and I was just about to got into our gate and Claire got behind me and yanked my hair "comeon" she said "no" I said "comeon because if you don't I'll smack you" she said "comeon you start comeon you chicken" so I did and she pushed me out of the telephone box and and when I started to fight my heart was thumping about 100 times a minute and I could not stand on my two feet they were like jelly. Then Claire's brother came on his B.M.X and started to cheer comeon claire smack her head in. noone was cheering for me I was feeling left out. Then my brother was coming down the hill but I kept on fighting because my best-friend was there and she thought that I was tough and I did not waint to get shown up so I tried to win at that time I had sharp nails and she pulled my hair so I scracthed all her neck and it was bleeding. Then my brother split it up there was no damage done to me. My brother took me and I was just about to get into our gate and Claire got behind me and yanked my hair

Age 9

22 PROPOSITIONS

J. A. Dichmont

1981

> One of the most interesting schools we visited was Lynncroft Junior and Primary School, Nottingham. John Dichmont, Head Teacher, and his staff treated the American visitors to a Tour-de-force in education. "Probably the best I've ever seen," was a common comment. Here are some of the notions which guide John's work at Lynncroft.

In school, we live in a perpetual emergency. Why? What is the problem? If we stopped and looked, perhaps we could see why we are under such pressure. Perhaps we could ease some of the pressure, or at least react more skillfully to it.

The Problem

1. Schools are used as dumping grounds for children. (The size of classes shows that children, teachers and teaching have not yet been taken seriously.) Partly for this reason the main function of much of what is done in school is to control and contain large numbers of children.

2. Schools are set in an unhelpfully authoritarian command and control structure. This kind of structure tends to get in the way. It gets in the way of learning. It gets in the way of personal and community development.

3. Society in general and parents in particular expect that schools will do more than control and contain children. They expect teachers to teach and that, as a result, children will learn. And this learning is often narrowly defined in so called academic terms. To complicate this picture further, teachers bring their own expectations to school with them.

4. It is impossible for a school to fulfill all these conflicting expectations. Just saying that creates a space, a sense of choice. When we teach, we are making choices about the kind of school for which we are responsible. This paper is an attempt to identify some important features of the space within which we make choices in this school.

Teaching Re-viewed

5. Parents make or break children. In school we can make a vital difference but in a relatively small area of a child's total development. It follows that teachers need to engage in dialogue with parents about the complementary roles of home and school. There is not enough time or energy to do this at all effectively, but the contacts we do make are all of them vital.

6. The simple proposition that "teachers instruct, and children absorb", is nonsense. Learning is a subtle, complex set of processes intimately linked to doing. A teacher has power to promote or undermine an individual's learning processes. But, to be effective, teaching has to be subordinated to learning. Some basic ways in which we do this are described here.

7. Although there are no perfect teaching methods, there is an evolution away from methods seen not to work and towards the realization of ideals. A school which does not continue to develop its methods and philosophy has begun to die.

8. When engaged in learning something, each child displays to the observer a unique pattern of strengths and weaknesses. When the task is particularly challenging, an individual child requires the full attention of the teacher, because the problems encountered will be unique to that child.

   It is self evident that children should be given challenging tasks in school. But teachers do not have time to pay attention to all the children in the class.

9. The essential quality of a skilled teacher is the ability to pay attention and to respond to the child. "The child's job is to learn the subject; the teacher's job is to learn the child." Teaching implies intervening; the skill is to make that intervention particular to the child and the occasion. In this sense, teaching is an intervention which releases learning.

10. With increasing skill and the accompanying awareness of what is possible for any given child, one becomes more and more aware of failing children because there are too many children to work with individually.

11. All schools with current teacher/pupil ratios neglect children. The most satisfactory compromise yet discovered is to encourage children to do without teachers - to take responsibility for their own living and learning in school, as far as they can.

    This frees the teacher to work with small groups or individuals to the greatest possible extent.

Other common compromises are less acceptable because they involve trivialising learning, boring children and inducing feelings of fear and failure.

12. Children are dumped in school for the whole adult working week. No one can learn intensively all week. School is the place where children live; and they learn for part of that time. The range of activities available and the pacing of the day, the week and the year, can reflect this. Part of a child's working week can be spent working intensively with the teacher, in a small group or on his own. Many other kinds of activity are appropriate for the rest of the week. Some of them relaxed, some intense. All of them can and do involve forms of learning, but learning is not their main purpose. The attempt to get children to learn all the time necessarily leads to trivialisation, boredom, time-wasting and dishonesty connived at by children and teachers.

13. A teacher can never even know about a great deal of the learning which goes on in the classroom let alone control it.

    In any case, many crucial kinds of learning can only take place without a teacher's controlling presence. This can be turned to positive advantage by the teacher.

    For example, it is a challenging task for a child to be given the responsibility to work on his own for a morning, a day or longer. It is a challenge to expect of a child that he should use his chosen task to control where, how, and for what time he works in school.

    As children increase their self-control, teachers can reduce their control of children. This means teachers can develop purer forms of action - in which, for example, teaching is more effectively subordinated to learning.

14. For the majority of adults, academic studies conventionally conceived are irrelevant. Not surprisingly, in the primary school many watered down academic studies are boring and irrelevant to most children. We know how to make topics from within history, geography, etc., interesting for children to pursue - provided they are treated as action-projects, occasions for talking and looking and listening and drawing and model-making, as well as for a small amount of reading and writing.

15. We aim to strengthen in children some fundamental attitudes to themselves and to their world.

    In maths, history, geography, science, we aim to develop interest curiosity and enjoyment, to foster problem-solving abilities, to help children to produce work of quality. This is a very ambitious set of aims. Related criteria for deciding whether to pursue a given topic with given children are: Can I make this topic accessible to them? Does it present a worthwhile challenge? How interesting can I make it? What work of quality can I expect?

16. We have developed among ourselves an awareness that teaching can also be a form of research into how children learn, and how adults can enable learning. The result is a school which continues to change and reform what it encourages children to do. One interesting discovery is that to teach children to read and write and do maths well, it is often necessary to do less of some of them. Practice does not make perfect.

School as a Community for Living and Learning

17. Our fundamental aim is to develop a community in the school. One in which each child and adult feels that they are recognised, respected and valued. One to which everyone feels they want to, and can, contribute.

18. We aim to foster in each individual a sense of personal worth, as well as a respect for others. It is not possible to love others if you do not love yourself. Children who are out of love with themselves are unlikely to be interested in learning about the world.

Feelings promote or inhibit learning; - children who are in a state of well being are interested in the world - though not necessarily in the artificial world offered in school.

19. Much of what teachers do in school is based on their anxieties. Anxiety for instance forces us to try to teach children to read before they are themselves ready and wanting to; the debates about phonics or context - clues etc., are all the results of these anxieties. Anxious teachers rarely pay attention to children. Most school work and adult actions in schools arise because we don't trust children to be able to organise their own learning. At times, we can only be aware of our anxieties, not do away with them. We still push reading and writing at children.

20. Our school aims seem to be good ones in parents' eyes; and in this we are only partly successful. This leaves us with enormous scope for development.

21. Our catchment area contains many adults who are culturally deprived, prejudiced and frightened of the new. To begin with, their children seemed to us to reflect these qualities. However, we have learned how to develop and bring out other, more positive qualities in the majority of the children we work with in school, by changing what we do and how we do it. We also try to be instrumental in developing a more constructive and positive attitude in parents towards their own children and towards school.

22. Staff are required to take responsibility for their own self-development as teachers, both as individuals and as members of a small community. Decision and policy making is, as far as possible, collective; and there is a continually renewed consensus about our purposes and methods. Adults need the same respect and personal support as children in order to grow.

SCHOOL ATMOSPHERE

Nancy Sweet

The aspect of British education that impressed me most was the atmosphere that prevailed in the schools I visited. There was a feeling of warmth, consideration, cooperation, respect, and love obvious the moment I stepped into the building. I noticed it at various levels: between head teacher (the closest thing to our principal or superintendent) and staff, head teacher and students, staff and students, and students with each other.

As visitors we were made to feel welcome immediately, but it soon became obvious that this same "belonging feeling" pervaded the entire building. One day in the lounge the head teacher nonchalantly said to one of the classroom teachers, "How about my taking your class around 2:30? You probably need a break today." Then later he told another teacher, "I'll be over to take your class around three or so if you like. I need to get more time with those little ones." That teacher taught six year olds.

In another school I entered a class of seven year olds and found the regular teacher busy at a table with about six students working on Cuisenaire rods. In the corner I noticed the head teacher sitting on the floor, working on a project with two or three students. He stayed about ten minutes and then went on to another area of the building. To my knowledge he wasn't in his office all day.

It's obvious that the head teachers I met have total respect for their teachers' competence and all of the adults respect the children's ability to learn what is presented. Although I saw no papers graded as we know it, I heard comments such as, "Are you sure that's your best work?" "This isn't at all tidy. Perhaps you'd better do this over and make it neater." The general attitude on the part of the teachers seemed to assume that a child would always want to do his best.

The children did almost everything in pairs or small groups. The cooperation between the children was surprising. I didn't see an air of competition in any of the classrooms I observed. Rather, students working together seemed genuinely concerned with helping their partners to understand and complete their work successfully.

In the schools I visited there are no report cards. Teachers meet with the parents two or three times a year to discuss the child's progress. No student is retained at any level regardless of performance. Since I was in such a limited number of schools, I can't generalize about all British schools. I don't know how widespread that particular policy is, but I couldn't help but wonder if it contributed greatly to the relaxed atmosphere of the schools.

Many classrooms had lounge chairs or rockers in them, and in a spare moment the teacher would be sitting holding one of her students on her lap. Teachers were always hugging kids, putting their arms around them, etc. throughout the day. How refreshing to see after the hands-off attitude in our schools, where teachers live in fear of being sued for touching a student!

I also suspect an inherent cultural difference. Our host and hostess for the week, Ann and David Thomas, were without a doubt the most considerate, helpful people I've met in a very long time. Other British people we met during our travels were likewise friendly and inordinately helpful. A couple we met in a church in Warwick took us home for dinner and personally led us back to the motorway so we wouldn't get lost. And of course, Sylvia Johnson and David Lingard were at our beck and call all week providing help in all areas (even extra practice stopping and starting on hills). I like to think Americans would be as gracious to visitors, but we live in such a hustle and bustle I'm not sure. The general pace of life seemed to be more relaxed than ours. So, perhaps it's only natural their schools would reflect this same atmosphere.

HOW TO MAKE A START

Mary Steffen

For most American teachers a visit in a British primary school is a compelling experience, leaving one both discouraged and ebullient. The students were autonomous learners who displayed great respect for their teachers. The teachers showed respect for both the students and their ideas. The results as seen in the student's work spoke loudly. These students could put to use everything they learned. Such could not be said of most American students.

It has been three years since my first visit in a British classroom. I am certain that there is much of great value in the British primary schools and that it is possible to incorporate that which is of value into an American classroom. Doing so results in a better education for our American students. They can do as well or better on standardized tests and they can think and solve problems as well.

I returned home armed with new topics for student study and an impression of a very different way of working. How could I create in my own American classroom a working relationship which would encourage the kind of productivity I had seen in England?

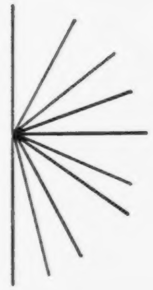
I offer here an account of an early attempt to practice some of the values I had observed. Incorporated in this account are many teacher behaviors which I have found to be of continuing usefulness in my British style American classroom.

HOW MANY ANGLES?

The diversity students demonstrate in approaching and solving a good problem can be a delightful experience for the teacher. Come along with me as I share one problem and several strategies and solutions which were generated by fifth graders.

The problem:

How many angles?



"What's an angle?" someone wanted to know.

"What do you think?"

"Is this one?" he asked, correctly drawing one on the board.

"Sure is."

Several others asked too, and some even needed to be shown. One aspect of encouraging students to become life-long learners is fostering an awareness of what information is not known. Sometimes a student is able to solve a complicated problem, but lacks a bit of specific information.

Soon the first boy returned. "Is this two angles or three?"

"Good question! What do you think?"

"Uh... I think it's three, but..."

"But what?"

"But what if that's wrong?"

"No harm done. If you find out it's wrong, try something else. In problem solving you sometimes find out more from wrong answers than from right ones. Sometimes you can look at a bunch of wrong answers and find a pattern that gives you an idea for the right answer."

This is a tough thing to do. Students are used to being given reassurance for right answers by an all knowing teacher. Changing that is often painful for both student and teacher. The reward for changing is worth the effort.

"I got 45. Come look at how."

That student is just as much in need of attention as the first, but her reward for learning has come from inside herself, rather than from my reassurance. She feels the power of knowing. Her need is for sharing her knowledge. My reward is watching her delight in her own knowing, and in my awareness that it is I who set the stage upon which she could begin to know for herself.

A new picture was drawn on the board. "Look! See, This is 1, 2, 3, 4, 5, 6, 7, 8, 9. Then here. That's 11..."

Fingers were pointing, then scooting around the picture. "Hey whoa!" I pleaded. "I'm not following that. Can we start over, slowly, so I can keep up?"

She stared hard at me. Was it possible that I didn't already know about her answer? Patiently she showed me her method of counting and keeping track.

"That's right isn't it!" she finished.

"Can you find a way to record what you just did in your notebook?"

Puzzled, she said she'd try.

Other students came to share. "I've got it!"

"Super! Let's see how you did it!

A notebook was thrust under my nose.

"Can you tell what I did?"

"Great question." This student really cared about making herself understood. I looked and then asked a few questions to check out what I thought she had meant.

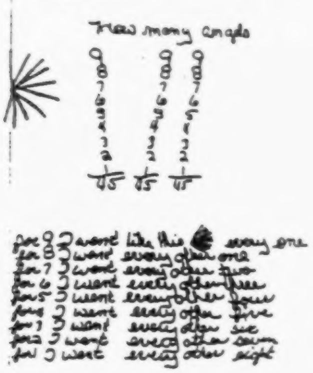
Modeling the kind of questions you are looking for from students is quite helpful. Playing the role of a learner yourself helps too.

What I picked up from being shown various solutions was only part of the diversity. As I looked at everyone's recorded solution I learned how diverse their thinking really was.

I asked some students for their notebooks, telling then I wanted to make copies so I could write an article about them for other teachers. Again, I was a learner.

The types of solutions I noted as I listened numbered only one. My own solution had been different. On paper there was at least a third. The recording methods were numerous. Here I share only a partly representative sample.

Some students were inclined to words.

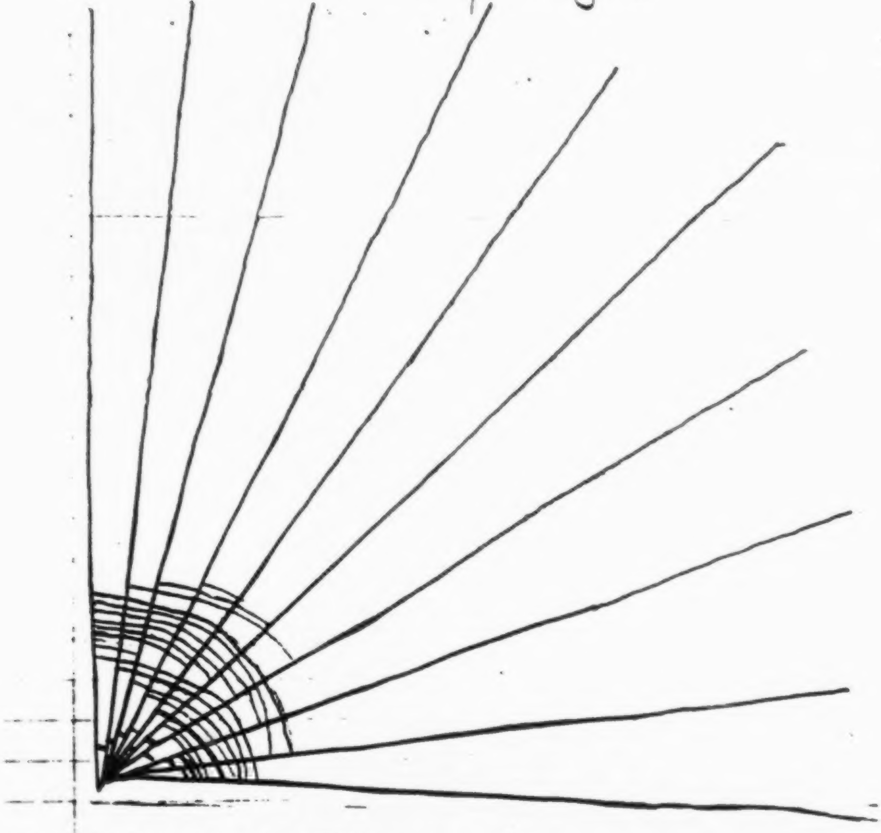

How many angles
9 8 7 6 5 4 3 2 1
45
9 8 7 6 5 4 3 2 1
45
9 8 7 6 5 4 3 2 1
45

for 9 I went like this every one
for 8 I went every other one
for 7 I went every other two
for 6 I went every other three
for 5 I went every other four
for 4 I went every other five
for 3 I went every other six
for 2 I went every other seven
for 1 I went every other eight

Most students organized their count using the attribute, size. Below another student used a color coded system to show the size and number of each group. In her original diagram, each different size of angle was drawn using a different color. The correct number of angles of each size were shown. Hers was a rather elaborate diagram. This black and white print of the student's color diagram loses detail, but the general idea can be seen below.

Michelle
Hopper

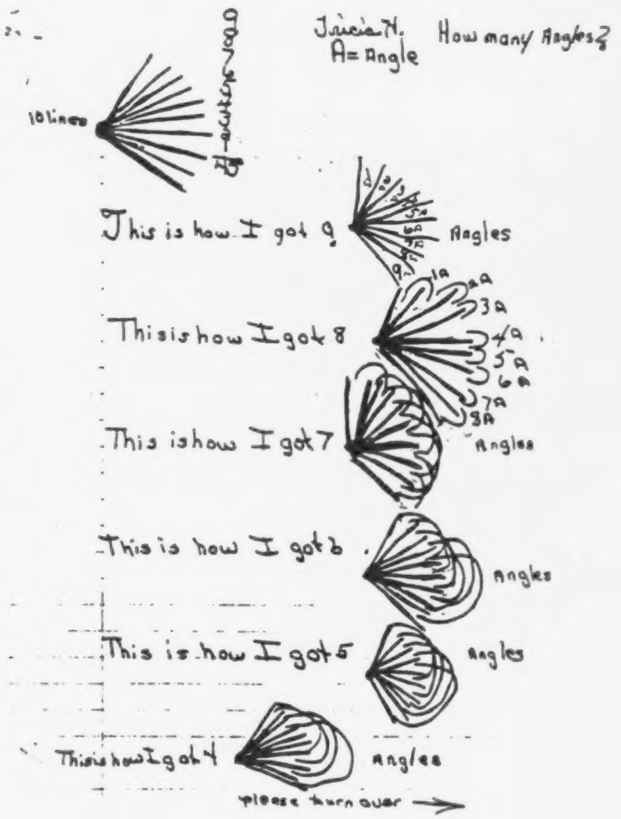
How many Angles

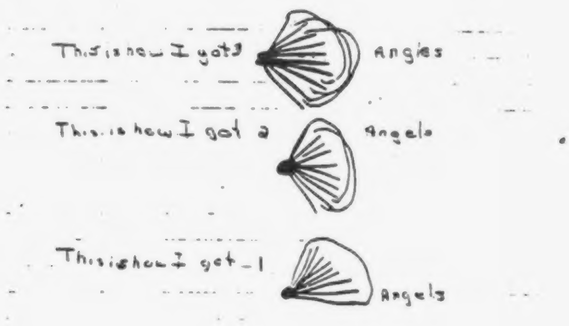


The ~~[illegible]~~ ~~color~~ colors are ~~to~~
show how big the angles are.

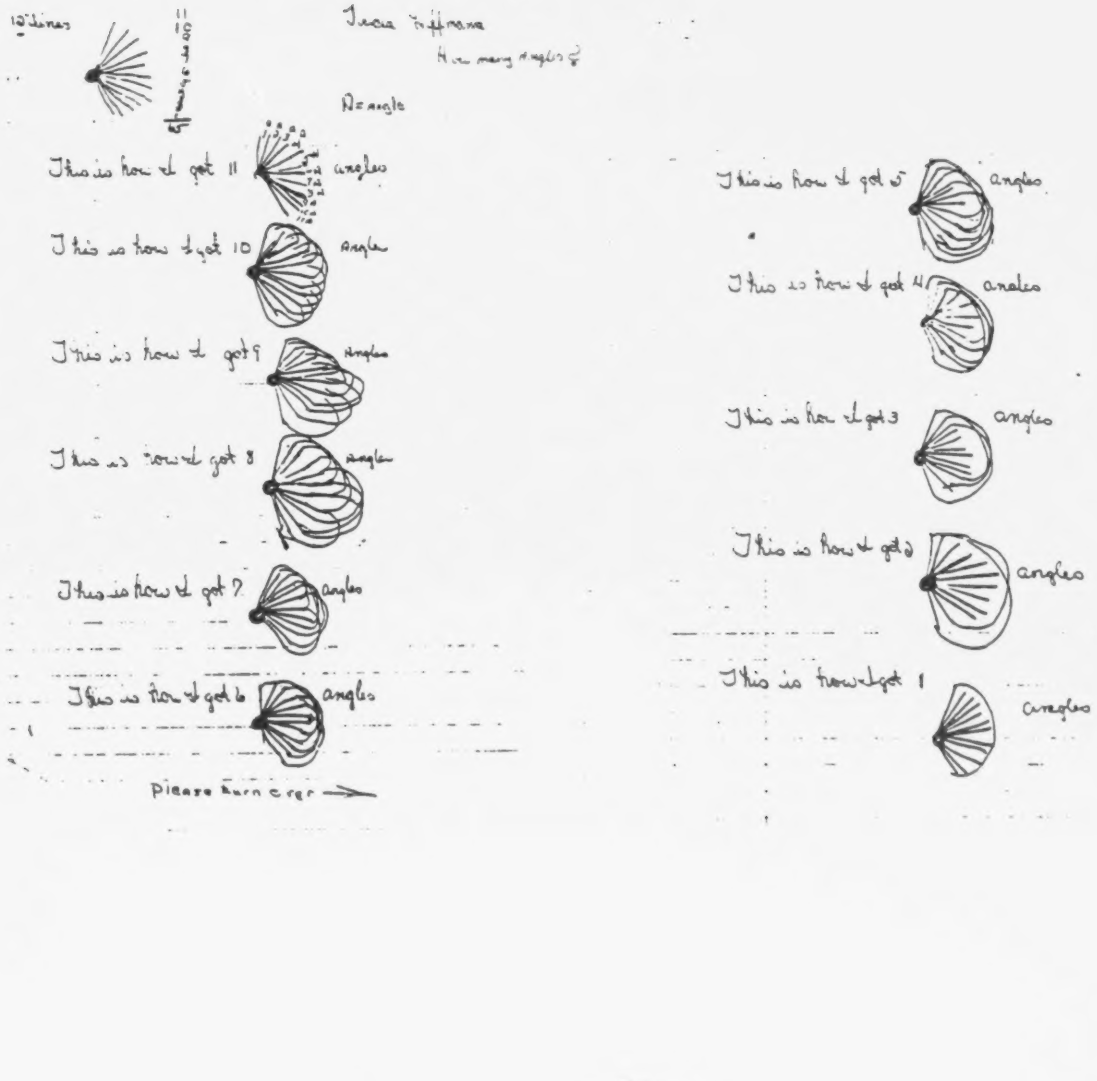
45 angles

Shown below, Tricia used a series of diagrams for clarity. She also classified by size. Tricia eventually went on to find the number of angles from 12 lines, again using the same diagram format. She then saw a pattern in finding the solution for any number of lines, and successfully found the solution for 20 lines using no diagram. Hers was a step toward generalizing a formula for all instances of triangular numbers. It isn't necessary to go further with most elementary students.


Tricia H.
A= Angle
How many Angles?
10 lines
45 answer
This is how I got 9 Angles
1A
2A
3A
4A
5A
6A
7A
8A
9A
This is how I got 8
This is how I got 7 Angles
This is how I got 6 Angles
This is how I got 5 Angles
This is how I got 4 Angles
please turn over →


This is how I got 3 Angles
This is how I got 2 Angels
This is how I get 1 Angels

Tricia has accurately listed the number of angles according to size. When she added, her total was off by one. No errors in thinking here, simply a clerical error. To have said to her, wrong, would have been an over simplification of the problem solving process. The major goal in problem solving is thinking. Clerical errors are easily corrected when one checks ones work for accuracy.


12 lines
11
10
9
8
7
6
5
4
3
2
1
65
1
2
3
4
5
6
7
8
9
10
11

Tricia Hoffmann

How many angles?

N = angle

This is how I got 11 angles

This is how I got 10 Angle

This is how I got 9 Angles

This is how I got 8 Angles

This is how I got 7 angles

This is how I got 6 angles

This is how I got 5 angles

This is how I got 4 angles

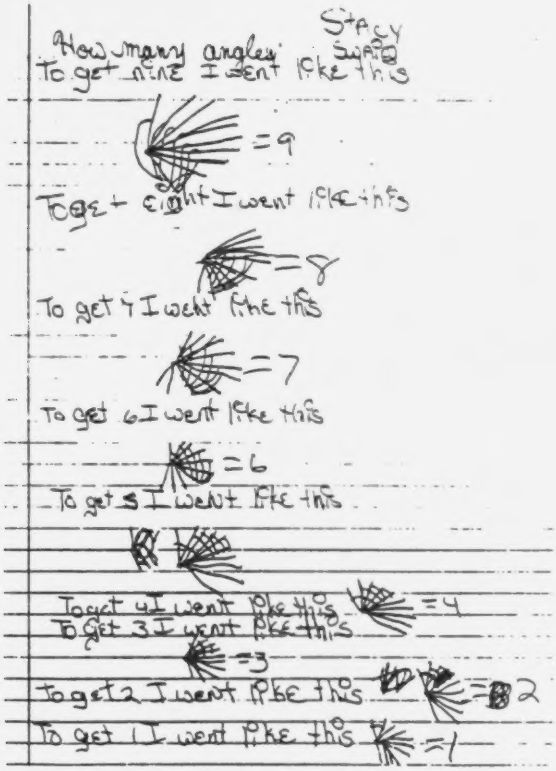
This is how I got 3 angles

This is how I got 2 angles

This is how I got 1 angles

Please turn over →

Stacy used a slightly different recording method and a completely different way of classifying the data.



Stacy
[illegible]

How many angles

To get nine I went like this =9

To get eight I went like this =8

To get 7 I went like this =7

To get 6 I went like this =6

To get 5 I went like this

To get 4 I went like this =4

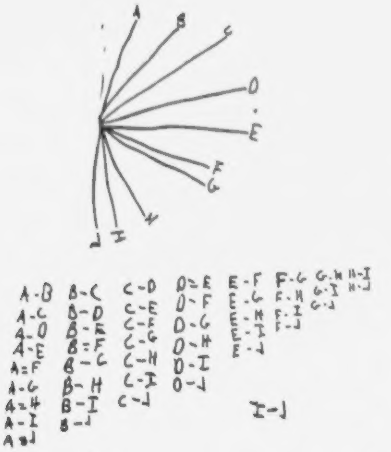
To get 3 I went like this =3

To get 2 I went like this =2

To get 1 I went like this =1

She focused on one line and made all possible angles using that one in combination with each other line. Additionally she organized such that she automatically eliminated any possible duplication. Her solution is more closely aligned with formal combinatorics.

John used the same organization, but a more sophisticated method of recording.



A-B
A-C
A-D
A-E
A=F
A-G
A=H
A-I
A-J

B-C
B-D
B-E
B=F
B-G
B-H
B-I
B-J

C-D
C-E
C-F
C-G
C-H
C-I
C-J

D=E
D-F
D-G
D-H
D-I
D-J

E-F
E-G
E-H
E-I
E-J

F-G
F-H
F-I
F-J

G-H
G-I
G-J

H-I
H-J

I-J

I asked John to say a bit about how he had gotten his solution. He made some interesting observations.

> Number all the lines. Start with 1 and match lines down. Then start with line 2 and match lines down. Then start with line 3 and match lines down. Then start with the next line and match lines down until you get to the last line. Then you should have more sets with line 1 than you have with line 2. You should have more sets with line 2 than line 3 and the same with the rest. Set 1 should have 9 angles, set 2 should have 8 angles, set 3 should have 7 angles, set 4 should have 6 angles, set 5 should have 5 angles, set 6 should have 4 angles, set 7 should have 3 angles,set 8 should have 2 angles, and set 9 should have 1 angle.

Insisting that students record may seem a bother, but again, results are well worth the effort. One student got into a hopeless muddle, losing track of where she had been and what was next. She asked for help. She had recorded in sets much like the boy above. Her sets showed these counts: 9, 8, 7, 5, 5, 5, 3, 2, 2. Since she had recorded her muddle, help was actually possible beyond an encouraging, "Just start over.".

Because her work still existed, I was able to say, "Look for a pattern in your totals. Maybe the places where the pattern is messed up will tell you where your mistake is."

She only had to check 5 of the small sets to find her mistake. She now automatically looks for patterns.

Additionally, the teacher can tell what the child already knows, and thereby tailor help to the student's real needs. To avoid solving the problem for the student is extremely important. Take away the intrinsic reward inherent in solving a problem and the learner again becomes dependent upon the adult for his/her rewards.

Just as we were finishing up, the girl mentioned at the start of this article bounded up with an entirely different total. 55, she thought was really right. She, as well as all the rest of us, had neglected to consider the back side of the original figure. Doing so made the sequence of numbers begin with 10 instead of 9, making the new total 55.

Problem solving is diverse, to the very end.

The teacher who shares the delight to be found in the diversity of students strategies and solutions with the class will encourage students to broaden and make more flexible their own minds. These sorts of rewards for the teacher are not immediate. It takes time for students to develop confidence enough to go where their own thinking takes them. Giving up immediate evaluation of right and wrong answers must first be replaced by the confidence and joy that comes in solving a problem. Knowing that I set the stage for the student to share the delight of discovery rather than requesting approval is a far superior reward; one quite worth waiting for.

(This article has been previously published in a recent edition of Mathematics Teaching)

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Marie Stevenson 8

ART AND ENGLISH EDUCATION

Judith K. Hall

The philosophy of the schools I observed in Sheffield, England is based on the belief that a child is an individual with capabilities and special skills which must be developed. To encourage development in aesthetics, each child is able to experience many art forms: drawing, painting, sketching in pencils or chalk, working with pottery, modeling through clay, woodwork and sewing. Their art classrooms (and/or art storage areas) have well-stocked facilities, enabling children to develop their ideas on a topic in their choice of art media. Teachers are present during work periods as facilitators, to encourage students to discover their individual problems first hand and find their own solutions. In addition to developing skills through practical experiences, children are encouraged to explore and develop an appreciation of art forms in their environment.

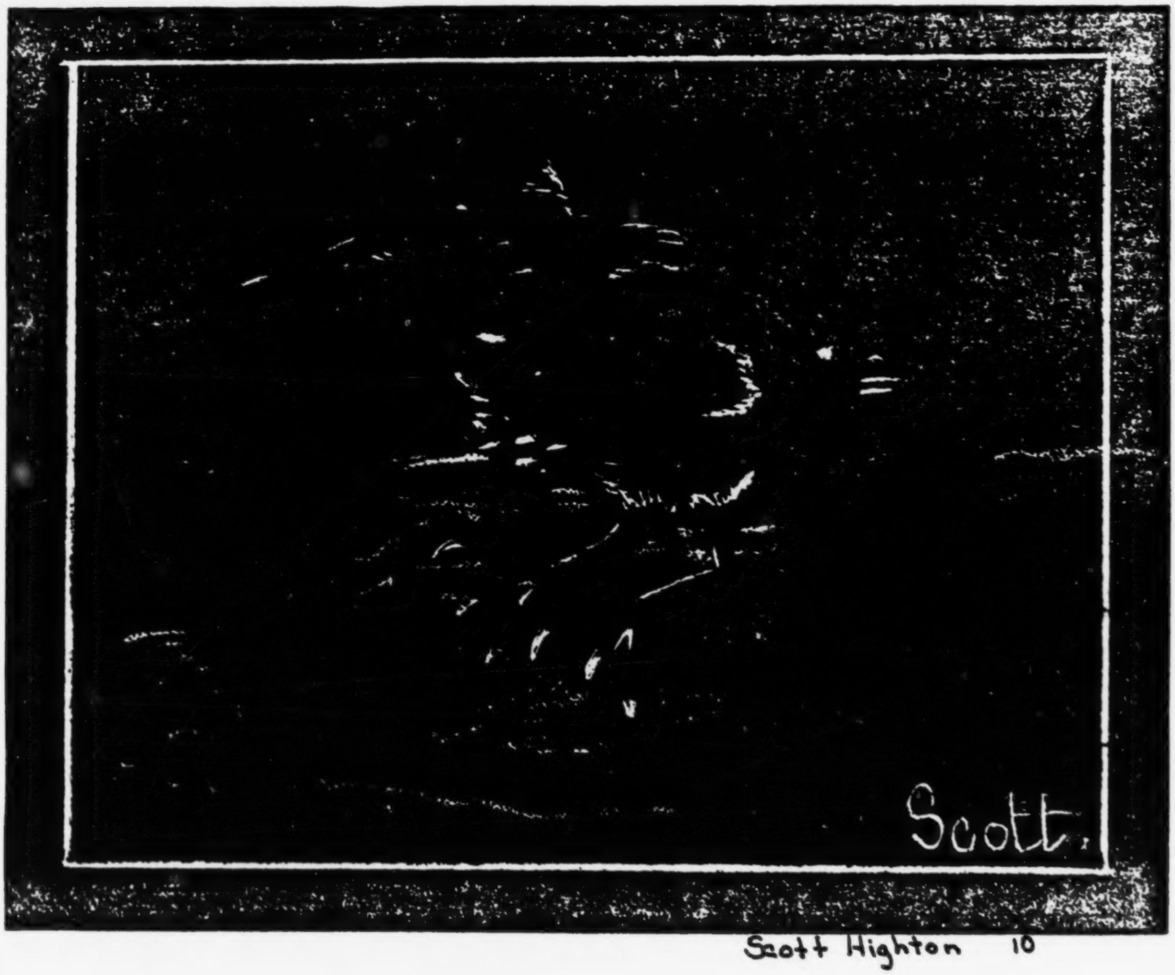
Art is felt to be an important part of each child's education and is taught as a subject in itself, as well as being incorporated into other subject areas throughout the curriculum. From the beginning, children are taught to draw through observational sketching using such skills as shading, shapes, contour, and proportion, to emphasize the essentials, suggest depth and distance, and thus achieve the desired effect. Additional skills are introduced as the child progresses. Opportunities to draw cartoon caricatures and still-lifes are numerous. One school had students look through books of Rembrandt, Van Gogh, etc. to find prints they particularly enjoyed. Once found, the students reproduced it through free-hand drawing, and proceeded to color it through the medium of their choice. Practically any child willing to make the effort produced representational drawings to be proud of.

At other times, children search for objects in books or the environment and incorporate them into their finished product. Children are often seen sketching on field trips and around the neighborhood. The students sketch, draw, and use various medium to finish the project. It is then framed with a colorful border to enhance the picture and displayed in the classroom or hallways. All wallspace is covered with children's work.

Depending on the school, students initially spend anywhere from one to two hours, one day a week formally working on an art project. Additional time spent completing the project depends on the school, teacher, and student. Projects may be set aside until the next scheduled art period, children may be allowed to continue during another activity period, or a child may decide to give up recess period(s) until the project has been completed. In any case, it is imperative the child finish the project.

The skills and aptitudes acquired in art classes are carried over and incorporated into other subject areas by relating art projects to an area being explored in other subjects. These activities are written into the objectives of the lessons being taught and are used to demonstrate a child's ability to perform a skill, or to show understanding of a concept.

Incorporation of art into the curriculum enables the children to produce beautiful pieces of artwork to be displayed throughout the school. This offers the children feelings of pride in themselves and their school. The children attack these projects - be they creative or attempts to copy reality or the masters - with enthusiasm. Comments toward inability or disinterest were not made. They listened to direction and immediately set about their work, giving it their all. The positive exchange of comments by children and teachers, the feelings of pride in their abilities, and the quality of work produced were refreshing to see.



Scott Highton 10

WHAT KIND OF EXPERIENCES? WHY?

Pat Lawrence

"Some of our children do not have, and are not likely to get, a wealth of experiences to draw upon in creating their concepts, so _we_ must give them."

This statement by the Head of Dalton Foljambe Infant School summarizes a guiding principle of the schools I visited in England. These schools were positively saturated with objects and events which furnished raw materials for analysis, replication and invention. Further, teachers reached out into the surrounding communities for meaningful activities to enrich their curriculum. I'd like to describe some of these ordinary materials and their relationship to the quality of student work I observed.

Saturate the environment

---with pattern

Walls were covered with fabrics, wallpapers, textured blocks and woods, drapes, flowers in hanging baskets, pictures in frames, student work artfully mounted, color variations, and architectural variety in windows and ceilings. Floors were covered with oak parquet, tile, brick, carpet, and vinyl. At first surprising in contrast to our sterile all-the-same classrooms, this richness felt very cozy and purposefully busy. Everyone cherished and protected the building and all its contents, feeling the sense of "belonging."

Children were led (by model and expectation) to close observation of details and shapes, accurate verbal description and reproduction in drawings, and constant evaluation of quality and esthetic value. Concepts such as balance, symmetry, proportion, rotation, form and color, were evolving out of daily experience.

The exceptionally high quality of art work was amazing. Obviously, art became the vehicle for other curriculum, not just a detached diversion on a free afternoon. The children utilized every kind of media: paints, pencil, ink, clay, fabric, paper, found objects, cut and paste, model building, blocks, wood, plastic, and metal beads to interpret their experiences. Carefully written descriptions or oral presentations of the products and their underlying experience were highly valued and shared all round. These activities comprised the real work of students' daily lives. (No wonder the children thought they just played at school!)

---With realia

Tables, cabinets, shelves were filled with displayed objects: rocks, shells, flowers, seeds, plants, and real stuffed animals loaned by museums, to touch, feel, explore, count, analyze, categorize, describe, evaluate, replicate, and share.

Teachers and students obviously used every available nook to display something they found important. Every classroom or area and even the halls, contained tables with manipulatives. Things for measuring: tapes, weights, rulers, cups, spoons, cubes, tiles, and rods, were accompanied by questions and objects provoking investigation, estimation, prediction, experimentation, calculation, and verification. Examples of mapping, charting, graphing and recording findings were displayed and discussed regularly. Objects from nature and the community were displayed, replicated, pictured, handled, discussed, written about, researched and reported. Everyone in the schools seemed aware of these artifacts because they were topics for assembly as well as everyday conversation.

---With sound

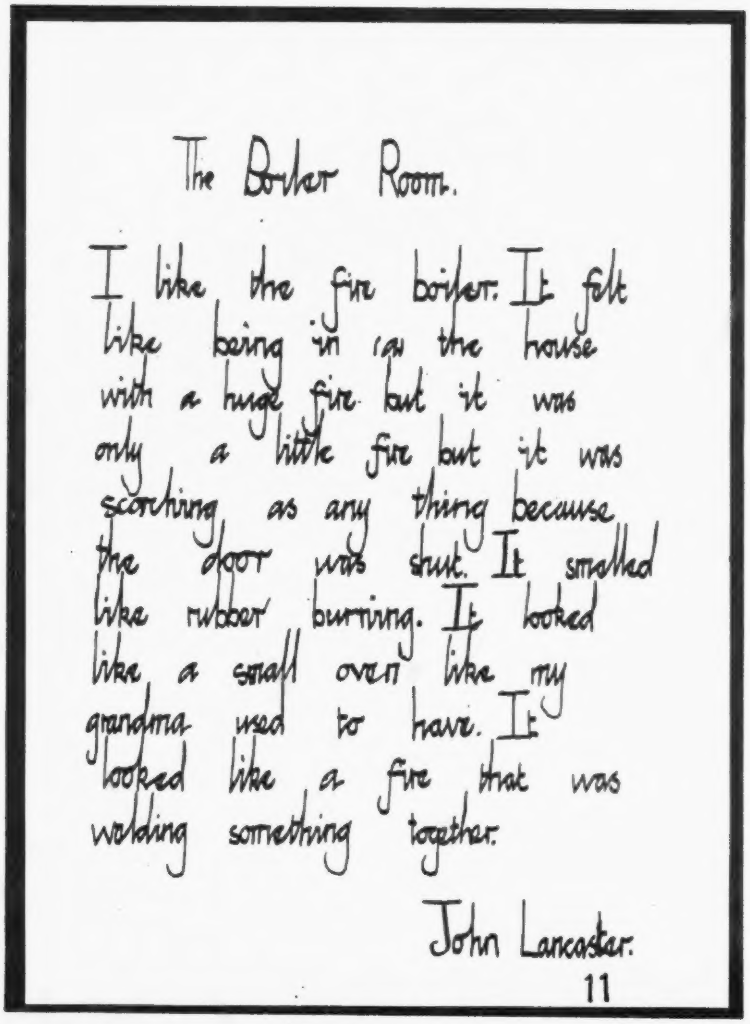
Music, laughter, silence, speaking, listening, and chatting all had their appropriate emphasis. Happily, music was an integral part of daily life: used to signal the beginning of class, to accompany the movement of students in and out of assembly, in an impromptu classroom recital to honor guests, for dancing with handicapped students from a neighboring school! Students who studied instrumental music were regularly given time in assembly to perform for their full community. In small groups or solo, they performed with dignity and competence. This also gave the young audience valuable experience in music appreciation and proper courtesy, as these ideas were emphasized and encouraged by the persons in charge. Students were naturally respectful and well mannered. Caring for one another seemed a high priority. (Competition was not prevalent.)

Most impressive was the articulate ability of children in every day conversation with adults! Because they had some knowledge of shared events and, because they felt their expressions were valued and encouraged, these children were able to put together very concise interesting commentaries and discussions with a lot of poise. They also seemed to have a well developed sense of "proper" listening and turn-taking. Nice. (I wonder whether our multi-lingual multi-ethnic student population in California, where I teach, will ever achieve this level of linguistic integrity?)

---With activities

These classrooms extended to take in all the outdoors. Topics of study included everything from the nearby plants and animals to local farms, woods, homes, seaports, beaches, towns and historical centers. A two-mile walk to a neighboring school to share dancing or sports, a day-long bus tour to York, an afternoon out counting the cars using a round-about or people entering a shopping mall, all furnished the raw material for further intellectual activity and useful production. The students at Concord Middle School were actually collecting and organizing data to be used in a government project of census-analysis of local needs. Their efforts were not casual busy-work or simulation! (Here, social studies, math, art, language, science, and esthetics all combined in one curricular unit.) Subject matter grows out of experience; school is not preparation for life, rather it _is_ life.

Experiences are the building blocks of concepts, but experiences with purpose, reflection and sharing are what make happy lives. The English schools I saw seem to be providing the most important kind of education -- the kind that gives young people the confidence to go on managing their own learning using the world as they find it.



The Boiler Room.

I like the fire boiler. It felt like being in ca the house with a huge fire but it was only a little fire but it was scorching as any thing because the door was shut. It smelled like rubber burning. It looked like a small oven like my grandma used to have. It looked like a fire that was welding something together.

John Lancaster.

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NO BELLS RINGING

Judy Barnett

English schools! I wish I was experienced enough, knowledgeable enough, and wise enough to make some profound statement about English schools.

I'm not. But I was lucky enough to visit two comprehensive (secondary) schools in the week I was in Sheffield, England. They were not completely alike. In fact, in some ways they were very different. I will try to reflect some of the most positive and rewarding aspects of these two schools. As you read this, do not take any comparisons to the American schools as a put-down or criticism of our system. Look at it rather as what is working in another place. There are many background differences between our two countries.

One other statement needs to be made: The kids are the same. You see the same expressions, the same kinds of smiles, the same mischievous sparkle in the eyes of some, the same need for recognition.

Let's start with explaining what their secondary school is. As I understand it, a comprehensive school is comparable to our public, free school. It starts with what is our sixth grade and goes through our tenth grade. The students stop public school at 16 years old or, if they do well on their exams, go on to two more years of secondary school preparing for university entrance exams. The top 10 percent of English students go on to college. Those not in the 10 percent top of their class get jobs or move on to some kind of job training. All this schooling is free.

The arrangement of a student's day is quite different from the junior and senior high school in our town. Their day starts with a 30 minute homeroom time where they do the usual lunch count and attendance. The class size is about 30 pupils. In this time slot they have a form teacher who has the freedom to schedule activities for his or her class and who is responsible for a student's problems, behavior, and homework completion. Some teachers use this time for current events, others for social interaction some present information on issues such as drugs, and in one, school assemblies were held once a week in this time period. At the assembly I saw a form teacher give an inspirational, devotional type message, including prayer. Her message was received respectfully. (Church of England prayer is common in state schools. Legislation mandating religious assurance is likely to be soon amended.)

After this, the students move on to their first class without bells dismissing them. I might be overreacting to the lack of bells, but it symbolizes something very important and I'll get back to that later. Pupils' classes are 70 minutes long with 20 minute breaks between the first and second, and the third and fourth classes with over an hour in between for lunch. Students have four classes a day, not the same four every day. During their breaks the students have designated areas where each grade level can meet or, in nice weather, go outside. These are unsupervised areas and the students behave decently. Wow!

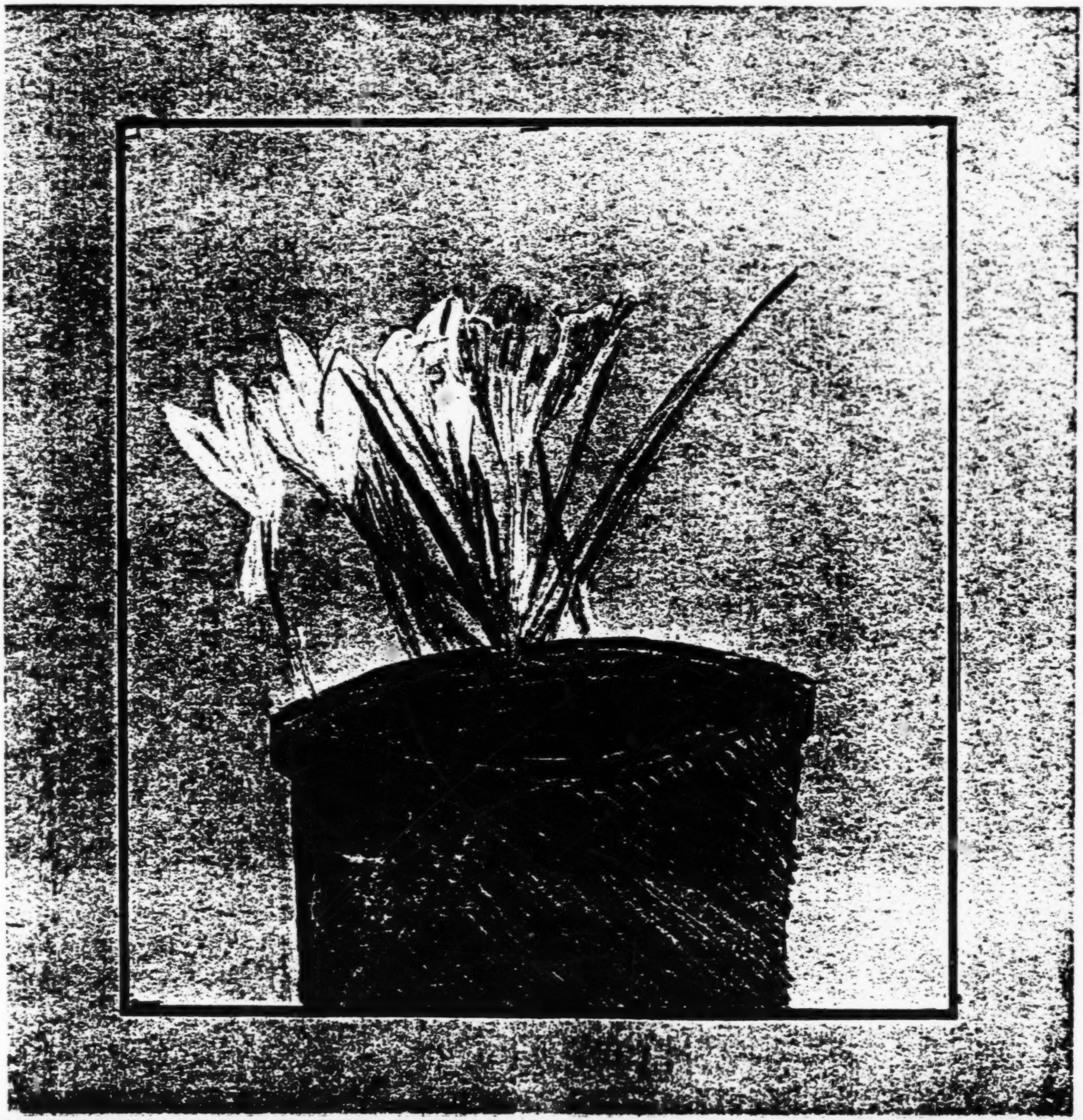
Their grading system is much different from anything I've seen before. Each student is graded with a written statement about their behavior and their academic performance once a year. The grades go out at different times of the year for different classes. (Some students are graded fairly early in the school year and yet they continue working through the rest of the year.) Evidently grades are not a major motivating force for these students.

No one is retained. When I told students how one must pass classes in the States or take them again, they were appalled. In the classes I observed, mainly math classes, students did a great deal of individualized work. The first two years were not tracked by ability levels but the upper classes were. I saw no textbooks in use, rather individualized booklets that had been chosen by the math department. Dittoes were not used as we use them in our schools. When a handout was used, more often than not, the student was expected to copy it into his or her own notebook and return the ditto.

There are many other differences and once again I state that I only observed two schools and one of these is not "average", even in England. But something special was happening here that interests me. I believe the philosophy of a school, and its principal, is a primary influence. You may have guessed from some of the previous statements that the schools are "student oriented." The school is there for the child and the school belongs to the child. Maybe that's why they don't destroy it in those free periods. The walls are covered with the student's art work. The form teacher is there every morning to assist his or her students in any way possible and the teacher has time to do so. Math is individualized by the math teachers, and they choose what's right for their students. They are not bound to a printed text. The bells are not used because they dehumanize people. With a break period behind each class there is no pressure to dismiss students at a given moment and students did not appear to be upset as to the exact time they were dismissed. (Teachers would finish a lesson and then dismiss the class.) The atmosphere in these classes was relaxed, congenial, and positive. Students were allowed to sit where ever they chose and work with fellow students when needed or when the teacher was busy with another student. There was a low talking range allowed in all these classes except one. In this class I watched the teacher constantly demand total silence. It was the most tense, uncomfortable class observed. (Tom O'Brien's note: I viewed this class and wrote in my notes, "Education by intimidation, impatience, and sarcasm.)

Another positive difference I saw was that teachers would go around a class, observe their students working and give a red check for correct answers. I was especially interested in this because I use a red mark when grading papers but I check the wrong one with that mark and they check the right ones. Still another thing was that the students who give visitors the guided tour were the so-called behavior problem students. They were used because they need attention and interaction with responsible adults.

I'm not trying to say English education is better than ours. But we certainly can continue to grow and learn from others. I hope that I will become a more effective teacher because of what I saw. I will always remember the positive atmosphere in the schools, the constant striving to nuture children, and the sense of relaxed accomplishment that was created there. I believe that some of this is achieved because there are no bells ringing.



PHILIP WOOD: A PHILOSOPHY FOR EDUCATION

Barbara Goldenhersh

Following is an address by the head teacher (principal) of Dalton Foljambe School telling of the workings of his school, the areas he feels are significant, and the hopes he has for his students. Within it are ideals and aspirations that guide his work. His discussions of self image, language, writing, maths, discipline, and the atmosphere needed to attain these goals (and how he went about implementing these as a head teacher) are instructive and inspiring to anyone who cares about the education of children.

I'm convinced that if children are to move on from here to their next school with confidence, then a number of things have got to have happened here. And there are things that aren't directly attributed to learning which concern me a great deal.

When I first came to Dalton Foljambe, I was struck by the fact that there was a large group of children at the top end of the school (children aged 9, 10, and 11) who didn't like school, who saw nothing to hold them here, to draw them here, to interest them. What that led to was the fact that they were very aggressive to each other and very unsupportive of younger children in the school. They tended rather to ignore them than actually to be unkind to them. It wasn't good. They had no obvious relationship with the adults in the school and they had no allegiance and no warmth to the building itself. This led to a number of problems. There were a lot of children here who saw no great value in school and who went to the secondary school with that sort of feeling very deep within them, and it was very deep within them indeed. This distressed me quite a lot.

Wanting to alter that, and feeling there were lots of things going on in the school, I moved in the direction of altering that attitude. First and crucial were relationships and the atmosphere within the school. The whole idea of relationships is vital, and I would see it in every possible looking. It's very important that the children see this as a society that they share, are a part of and carry responsibility for. It's important that they are able to work together, to play together, to share together, to be friends together. This holds not only with age groups that are similar, but I want my older children to be very caring of my younger ones and to be able, where it's possible, to play a role that is healthy and sharing and caring with them.

This is very easy to say but not so easy to do. It takes time, and every day you take two steps backward with somebody.

It's also important, I think, that we, as adults in this place, get on in the same way. We're not always going to agree on everything, but, by and large, the way we relate to each other and get on together and talk about things is essential. This involves not just the teaching staff but all the adults -- the dinner ladies, the caretakers, and so forth.

It is also vital that the adults treat the children as human beings. This, I think, is still very much ongoing. I was struck when I came by the different ways in which some of the adults approached the children. It varied tremendously, from attitudes that I thought were terrific to attitudes that set a barrier between children and staff. The relationship has to be right and I've worked fairly hard over three years to try and show the staff how I want them to treat the children. As I've said, it takes a lot of time. This is crucial to me. So the atmosphere within the school, how the place feels, depends on how the human beings are within it.

There is discipline in the school like there is in any other. But it is not always so neat and clean. There is time when I am very unhappy with sometimes large groups, sometimes with individuals. Nevertheless, things have got to happen is such a way that children know what the rules are and know that they are fair. They need to know and they do know what they can do and what they cannot do. And they appreciate that if they overstep the rules, certain consequences will come from it.

As I say, the atmosphere within the school is very, very important. Having said that, we've got to look at what we've got. What we've got are a lot of children who are very short on experience, real life experience, that the majority of us have as a right of life and take in a stride without even caring or thinking about very much. For these children these experiences don't exist. So I think it's important that we provide these experiences. This brings me round to working within the concrete, to working as far as possible on experiences that are first hand and taking our school work from them. Whether these experiences be decided on by the teacher, whether they be seized upon because it's the time of the year, or, because somebody's brought something in to class, or whatever, what the children see each day is an environment that cares and an environment that is interesting. They go into classrooms that are carefully thought through by the teachers in terms of what is put out, how work is set up, how the room is organized and arranged, and so forth.

The environment they've got is alive and it concerns them and is about them. The corridors also reflect that. The children's work appears first in the classroom. When it's done there and the teacher wants to change, it comes out and goes into the corridors so it is seen by the larger group. After that it goes, it's finished. The most important thing is the doing of the work in the first place. (I hear people say that once it's done it can be ripped up. There's a truth in that.) The most important role is in the actual doing of the work and the child's learning through the doing. The seeing of the work by other children is secondary, it's actually important but it's secondary.

Obviously, we have subject areas, but we do not see them initially as entirely separate from each other. We see that within the language we do there is perhaps some number concept or maybe a science idea. Within the drawing that is going on, there is an awful lot of talking, and an awful lot of looking. Within first hand experience we're trying to develop spoken language.

To get quite specific about language, let me say that we are quite concerned about children's confidence in spoken language. The ability to be accurate and to sequence and relate ideas and events. We are concerned about a child's ability to talk one to one, to a small group, to the class, and to the whole school. And we help children to develop the language that's written, but through the things that children understand and have happened to them.

> At this point, a child entered to share a poem he had written with Mr. Wood. The child was treated with respect, Wood offering his total attention He then resumed his discussion.

We can talk specifically about this child instead of talking in generalizations. It interests me that first of all he obviously enjoys the work. It is quite happily done. He is pleased to sit down and write which is good, (When I came here there weren't many children who would willingly have sat down to write.) It is interesting that a lot of the work I read just now has come from his early works. He has written about the sea, because in February his class spent a week at a place not too far along the coast. The image came from a piece of children's writing which I read this morning in assembly, and he's used that to relate his experience at the sea. He knows how he wants it finished and he wants it typed. This ties into what I said about actually wanting to do things (which he does) and relating it back to experiences (which he has done) but also to being aware of other work in school and learning from that (which he has also done.) It is easier to develop writing through children actually wanting to write than from, say, an exercise from a book or an exercise where you just fill in words.

Given this, you can talk about spelling, punctuation, and what have you, through the work the children do rather than as entities in themselves. That's what we would do. We wouldn't start with punctuation or with work on the parts of speech. We'd start with some piece of writing which stressed something this child needs to know more about, something the child wanted to write about.

When I came here a fellow who is not here now had set his fourth year juniors, that's my oldest children, to do a piece of writing about what it was like living in a medieval village. He came in to say how disappointed he was with the writing. And I said, "If you'd given me that to do, heaven only knows what you'd have got from me. It probably wouldn't have been even a decent sized paragraph. I know very little about medieval life." How can you expect a 10 year old to pull rabbits out of the air? It is not possible. You have to work at things gradually and slowly and build up and expand. The kids have got to be confident. And they have to have experience.

We work hard to build up the confidence of these children. It is a task to cause them to think that they can do it and is absolutely easy to cause them to think that they can't. It's the easiest thing in the world to convince a child that he can't do something. If you go the other way about it and seize on what he can do, which might be minimal, and cause him to think that he can do this or that, he's got some status within the classroom and some confidence in himself and you can build on that and go forward.

Within number (maths), there is in actual fact a scheme (curriculum) of books which runs through the school, which was put in by the previous head (principal). I hope it is used sensibly, and where we're talking about concepts, about understanding, I want us to have a lot of apparatus, a lot of equipment, that we also use to develop children's thinking and children's understanding.

We talked about first hand experience. It's important to develop. One of the difficulties with this (and I am sure other heads, if they were honest would agree) is that it's possible to get first hand experiences going in your school. Children relate to working from their own experience, to writing about their own experience, to drawing about their own experience, to talking about their own experience, to making maps from their own experience, and so on. But it is possible then to underrate what children can achieve. It is possible to be asking the top junior level (age 11) what's being asked the top infant level (age 7). This is a danger. It is important that as the children get older, they're asked to work more widely than they're asked to at seven. At Dalton Foljambe, you see work on maps begin to appear and you see children beginning to use reference books more and more widely in terms of research. You see children use dictionaries and encyclopedias with growing purpose and accuracy. You see children setting up experiments, working scientifically, being able to provide work of some historical nature and base. You see children beginning to write in different ways -- having a go at something that has to do with verse, that is in some way poetic. You see children writing stories and as the stories go on they move more and more away from themselves and rely more and more upon imagination and even, though it's rare, fantasy. I don't think we are good enough at that yet. I hope that will come in the next two or three years. It comes from a lot of other experiences first. (I do come across in other schools, from time to time, pieces of writing that children have done that are, in actual fact, fantasy, but they really aren't well written. The children seem not to be aware what they are doing and kind of rabbit on for ream after ream without going anywhere.) Fantasy is difficult to do because fantasy has some reality within it. It might be reality of place or reality of person, but there's something that holds it to the reader and I think 7 or 8 year old's pieces of writing don't do any of that. It is difficult to do and we are nowhere near that stage in the writing.

The mechanics of the writing would be going on all the time throughout the school, being developed by teachers' talking about different aspects as the children get older. When you look at what the children in my fourth year junior classes have been asked to think about when they write, you'll see that what they're being asked to think about is enormous. Let's say they're writing a story. First of all they've been asked to think about the content of the story, about the shape of it. Before they've written it, they've got the general idea about where they think the story is going, where it's beginning, where it's developing, how it's ending, and so forth. When they begin, they need to think about sentences, capital letters, spelling, use of language and the sort of words they are going to use. They need to think about the sequencing of the story. They need to think about handwriting. We expect all this of them and it is very, very demanding.

All of it comes down again to relationships and the staff knowing their children. It is easy to come across a piece of work which looks messy but might have within it a tremendous amount of good. There might be another piece of work which looks beautiful but is, in fact, banal, is lacking in ideas, is poorly put together. Somebody might be saying to that child, "Very, very good," and saying to the one whose work looks messy, "This is terrible. Go and do it again," when in fact it was that child who needed tremendous praise for the ideas, the language, the organization of the work. It is better to look carefully at the work and say, "What a pity. Perhaps next time, if you can make it look better, people will come and read it more happily, won't they."

Initially, when the children are in the infant end of school and the bottom end of the juniors (7, and 8) everything is first time written. As the children get older they tend to be writing more: there tend to be more things to think about, and there tend to be more situations where things are alterable within the work. There comes a time where children begin to rewrite and reorganize. We've got to remember that at the comprehensive (secondary) level, after they leave here, they're practically never going to be given the opportunity to write and rewrite. They are going to write and that's it. So we've got to be aware that, where possible, the eleven year olds are back to first time writing. The boy that brought in the poem earlier wrote it straight out. (His poem follows this article.)

When I came to the school the writing was awful. I see it getting better. I think it's got long stages to go but I begin to see children who at last are enjoying writing and who are getting and giving some warmth with their writing. If I sat down with a piece of paper and didn't know how to write and if what I've been asked to do isn't very exciting, and when it's done it's going to disappear somewhere and nobody is going to see it again, then maybe I wouldn't bother sitting down writing either.

There is so much that can be asked of children in terms of writing that would be exciting, that would be interesting, but you've got to give children things to write about that they can get their teeth into to start with. You, as a teacher, have got to be very aware of the situations you've set up and what you are asking. You've got to know your children individually. You've got to care about the work. If you just say, "You finished? Thank You. Put it on there," it's a waste of time. You've got to look at it. You've got to go through it with the child and get the child to read it to you. You've got to read it thoughtfully yourself. There is always something to talk about in every piece of work with every child, and I hope there are always positive things. And I hope the staff are also looking for the negative things -- thinking, for example, "I've got to talk to her about putting more thought into subject matter," or "I've got to look at this child's handwriting, it's just not good enough," "Got to look at spelling," "Got to look at sentencing." But you've got to be very careful how you do it. If you hit that as the top thing and the poor child sat down there for heaven knows how long and done the work and then gets taken apart for it, then next time they won't want to do it at all. You've got to be very careful to cause them still to want to write and get excited from it and to develop the language they're using within the work.

One of the things that forcibly struck me when I came was that it was not possible to differentiate between the writing of the oldest children and the writing of my eight year olds in terms of the quality of the language. If you didn't look at it, if it was only read out, then what 11 year olds had written could have been written by 7 year olds. Now I would feel that the writing that some of the older children are doing just couldn't be written by a 7 or 8 year old because they haven't got that facility with language and they haven't got the vocabulary. Some of that comes through reading. The children read every day. Certain aspects of the reading are recorded by the child, particularly to do with words -- words they happen to have been misunderstood, words not met before -- which then, from time to time, reappear within the writing of the child. But it's a slow process which is why, when I came to the school and the children in the top end of school had this attitude to school, it was unbreakable. There was no way in twelve months, that I was going to see things turn around. It took time and patience.

When children feel that school is a good place, that the people there are fair, that their relationships are stable, they can build skills in language, in reading, and in mathematics. They can go and tackle those academic areas and feel that they can handle what's been asked, and have the confidence to go on."

1985
June 1985 18th

Walking in the Sea

1 Gentle at first
Then it gets stronger
The high waves
Rush in

2. The foam rushes over my head
My legs felt like ice
My trousers were
Drenched.

3 The hairs on my arms and
Legs stood up on end

4 I felt as though I kept moving with
The Sea

5 It all went calm So I

Walked away drenched by the sea

By Simon Wray
age 10

Cockcroft:

An introduction for primary schools

Mathematics counts,[*] the report of the Cockcroft Committee of Inquiry into the teaching of mathematics in schools, is the most authoritative document about school mathematics to be published for many years. It contains much of importance for those who teach mathematics in primary schools. In a Parliamentary statement the Secretary of State for Education and Science said that "the report has set out an analysis of the purposes of mathematics education which is striking in its realism and lucidity. It has put forward recommendations which call for early action by all involved. . . . Our task is to build on the foundations which the Cockcroft Committee has laid." This is a task in which each primary school needs to take part.

This paper is an introduction to the report for teachers in primary schools and sets out some of the messages from the report which are of particular relevance to those who teach mathematics in the primary years. The Cockcroft Committee has presented its arguments and conclusions in a way which makes them accessible to those who are not mathematics specialists and this paper often makes use of the words of the report itself.

This introduction is not, however, in any sense a summary of the report nor a substitute for it. It is, therefore, important that a copy of *Mathematics counts* should be available in each primary school for teachers to consult. It is important, too, that the head and at least one member of staff should have a clear view of the report as a whole so as to be able to explain and interpret the relevant sections to colleagues.

[*] *Mathematics counts*. Report of the Committee of Inquiry into the Teaching of Mathematics in Schools under the Chairmanship of Dr W H Cockcroft. HMSO £5.75

Some messages from the Cockcroft report

Why teach mathematics?

A principal reason for teaching mathematics must be its importance and usefulness in many other fields. The study of mathematics can also help to develop powers of logical thinking, accuracy and spatial awareness, though the extent to which it does so depends on the way in which mathematics is taught. The inherent interest of mathematics and the appeal which it can have for many children and adults provide yet another reason. However, the most important reason for teaching mathematics to all children is that it can be used as a powerful means of communication – to represent, to explain and to predict. All of us need at some stage to read the numbers on houses or buses and the price labels in shops, or to calculate how long a journey will take; some need to be able to estimate how much petrol will be required for the journey and perhaps also how much it will cost.

Mathematics can be used to present information in many ways, not only by means of figures and letters but also through the use of tables, charts and diagrams as well as of graphs and scale drawings. However, the extensive use of a variety of symbolic notation which enables mathematics to be used to communicate information concisely and unambiguously is also the cause of its difficulty for many people. The solution of a mathematical problem cannot begin until the problem, stated or thought of in words, has been translated into the appropriate mathematical terms. It is this first and essential step which many people, both children and adults, find so difficult and to which too little attention is often paid. Unless a problem can be expressed in the appropriate symbols, it is of little use to be able to manipulate those symbols. This is the reason why practice in computation, undertaken by itself, so often produces no improvement in the ability to make use of mathematics in everyday situations.

Mathematics is a difficult subject both to teach and to learn. Many people take a long time not only to become familiar with mathematical skills and ideas but also to develop confidence in making use of them. Those who have been able to develop such confidence with relative ease should not uinderestimate the difficulties which many other experience, nor the extent of the help which can be required in order to be able to understand and to use mathematics.

Mathematical needs of adult life

A study[*] commissioned for the Cockcroft Committee showed that, although there were many people who were able without difficulty to cope with the mathematical needs of their everyday lives, there were many others of whom quite the reverse was true. Indeed, the extent to which the need to undertake even an apparently simple piece of mathematics could induce in some people feelings of anxiety, helplessness, fear and even guilt was perhaps the most striking feature of the study. Nor were such feelings experienced only by those who lacked academic qualifications. Some whose academic qualifications were high nevertheless lacked confidence in their understanding of mathematics and in their ability to make use of it; for this reason career choices had in some cases been seriously reduced. It was clear, too, that there were many people who had far from happy recollections of their mathematics lessons while at school.

The mathematical needs of adult life include

- the ability to read numbers and to count, to tell the time, to pay for purchases and to give change, to weigh and to measure, to understand straightforward timetables and simple graphs and charts and to carry out any necessary calculations associated with these;
- the 'feeling' for number which permits sensible estimation and approximation and which enables straightforward mental calculation to be accomplished;

[*] Use of mathematics by adults in daily life. ACACE, 19B de Montfort Street, Leicester LE1 7GE.

present, and to ask questions about them. Some calculators should be available in primary classrooms; these can be used as an aid to discovery and investigational work, to reinforce understanding of place-value and to enable children to deal with problems arising from real life in which the numbers involved can often be 'awkward' from a computational point of view.

Links with other curricular areas

The experiences of young children do not come in separate packages with 'subject labels'; as children explore the world around them, mathematical experiences present themselves alongside others. The teacher needs therefore to draw mathematical experience out of a wide range of children's activities. When planning these activities, especially any extended topic or project work, the teacher should try to identify at the outset the mathematical possibilities which exist within them. Not all of these possibilities will necessarily be realised but by planning in this way it becomes easier to make the most of whatever opportunities present themselves and perhaps also, by appropriate discussion, to draw attention to others. The overall aim must be to develop in children an attitude to mathematics, and an awareness of its power to communicate and to explain, which will result in mathematics being used wherever it can illuminate or make more precise an argument or enable the results of an investigation to be presented in a way which will assist clarity and understanding.

Range of attainment in mathematics

Teachers need to be aware, and to take account, of the very great difference in attainment in mathematics which can exist among children of the same age. For example, research evidence shows that an 'average' child can write down the number which is 1 greater than 6,399 at age 11 but not at age 10. However, there are some 14 year olds who still cannot do this correctly and some 7 year olds who can. Similar comparisons can be made in respect of other topics. There can therefore be a 'seven year difference' in the attainment of children at the age of 11 and so the mathematics curriculum in a primary school, as in other schools, needs to take into account the wide range of understanding and skill which can exist within a class. Efforts must be made to match the pace and level of work in mathematics to the attainment of pupils. This is not an easy task but is essential if confidence in using mathematics is to develop.

A consequence of the 'seven year difference' is that it is not possible to make any overall statement about the mathematical knowledge and understanding which all children of any given age should be expected to possess. This has important implications for those who are concerned with the preparation of guidelines and schemes of work, as well as with procedures for transfer from primary to secondary school.

Organisation of mathematics teaching

The various methods which are commonly used to organise teaching groups for mathematics all have both advantages and disadvantages; no one method is universally suitable. However, all primary schools should examine the extent to which the form of organisation which they are using enables the best use to be made of the mathematical strengths of their staff and provides continuity of teaching in mathematics for the children in the school. In all but the smallest schools, a member of staff should be designated as 'mathematics co-ordinator'. It should be part of the duties of the co-ordinator to

- prepare a scheme of work for the school in consultation with colleagues;
- provide guidance and support for other members of staff in implementing the scheme of work;
- organise teaching resources for mathematics;
- monitor work in mathematics throughout the school;
- assist with the diagnosis and remediation of learning difficulties;
- arrange appropriate school-based in-service training;
- maintain liaison with other schools and with advisory staff.

The overriding task must be to provide support for all who teach mathematics and so improve the quality and continuity of mathematics teaching throughout the school. Good support from the head teacher is essential if the mathematics co-ordinator is to be able to work effectively, and some modification of the co-ordinator's teaching timetable is likely to be necessary in order to make it possible to work alongside other teachers. Appropriate in-service training for the co-ordinator will also be required.

More about the report

This short introduction to the Cockcroft Report includes only a small part of the report's message for those who teach mathematics to children of primary age. There is much else in the report which is relevant to the work of primary schools. Among the sections to which no reference has been made are those on the differences in mathematical performance between girls and boys, the development of understanding and memory, the need to develop skills of estimation, the use of mathematics to solve problems, the teaching of mathematics to children whose attainment is high and to those whose attainment is low, the preparation of mathematics guidelines and schemes of work and the particular problems of small schools. There are chapters in the report on assessment and continuity, and on facilities for teaching mathematics. The full scope of the report is indicated by the list of chapter headings which follows; those chapters which are especially relevant to the work of primary schools are indicated in bold type.

Reading list

1 **Mathematics Counts.** Report of the Committee of Inquiry into the teaching of mathematics in schools HMSO£5.75
2 **Use of mathematics by adults in daily life.** ACACE, 19B De Montfort Street, Leicester LE1 7GE £2.50 (post free)
3 **Primary education in England.** A survey by HM Inspectors of Schools HMSO £4.50
4 **Education 5 to 9.** An illustrative survey of 80 first schools in England HMSO £3.50
5 **Mathematics 5-11.** A Handbook of suggestions HMI Series: Matters for Discussion 9. HMSO £4.20

Mathematics Counts: Contents

Part one 1 **Why teach mathematics?**
2 **The mathematical needs of adult life**
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6 **Mathematics in the primary years**
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16 Some other matters
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- sufficient confidence to make effective use of whatever mathematical skill and understanding is possessed, whether this be little or much.

Although not all adults are able to achieve success with the whole of this list, the objectives which it sets out are within the capability of very many and the extent to which they are achieved will depend in large measure on the foundation of mathematical understanding which is laid in the primary years.

Attitudes towards mathematics

The study into the mathematical needs of adult life found that failure and consequent dislike of mathematics was often ascribed to a specific cause when young and this conclusion is supported by other studies to which the report refers. For example, "strongly polarised attitudes can be established, even amongst primary school children, and about 11 seems to be a critical age for this establishment" (para 205). It is therefore important that children should be helped to develop positive attitudes to mathematics from their earliest days at school. During every mathematics lesson children are not only learning, or failing to learn, mathematics as a result of the work they are doing but are also developing their attitudes to mathematics. In every mathematics lesson their teacher is conveying, even if unconsciously, a message about mathematics which will influence these attitudes. Once attitudes have been formed they can be very persistent and difficult to change. Positive attitudes assist the learning of mathematics; negative attitudes not only inhibit learning but very often persist into adult life.

Very young children usually show an uninhibted enthusiasm and curiosity; school is enjoyable and they learn rapidly and with interest as they encounter a great variety of new experience. The challenge for the teacher is to present mathematics in a way which continues to be interesting and so allows understanding and confidence to develop. During their visits to primary schools, members of the Committee met a number of teachers who were succeeding in presenting mathematics in this way and whose pupils were clearly enjoying their work. However, not all the teachers whom they visited were achieving this level of success. Even in schools in which the general atmosphere was lively and supportive, the need of children to work at mathematics in practical ways had not always been realised, so that attitudes to mathematics in some classrooms contrasted strongly with attitudes to other work.

Parents

Parents can exercise, even if unknowingly, a considerable influence on their children's attitudes towards mathematics. Encouragement to make use of mathematics during normal family activities can assist children to develop familiarity with numbers and confidence in making use of them. However, in some cases parents can expect too little or too much of their children. It can happen, too, that parents fail to understand the purpose of the work which their children are doing and so make critical remarks which can encourage the development of poor attitudes towards mathematics. It is therefore important that schools should make active efforts to enlist the help of parents by explaining the approaches to mathematics which they are using and the purpose of mathematical activities which parents themselves may not have undertaken while at school.

Primary mathematics curriculum

The increasing use of approaches to mathematics which are based on practical experience has led to a widening of the mathematics curriculum in most primary schools during the last twenty years. This is to be welcomed; it has had a beneficial effect both in improving children's attitudes to mathematics and also in laying the foundations of better understanding. However, work of this kind needs to be carefully structured with due regard to planning and continuity, to methods of assessment and recording, and to consistency in the development of work in the school as a whole so as to ensure progression. Furthermore, much of its value will be lost unless it is followed up by discussion with the children so as to establish the necessary concepts and make links with other pieces of work which have been undertaken. The primary years are a time when children, in addition to acquiring the skills of language and number, are experiencing a variety of methods of learning; they are learning to think, to feel and to do, to explore and to discover. The learning of mathematics should contribute to these experiences.

The primary mathematics curriculum should therefore not only equip children with the mathematical understanding and numerical skills which will be a powerful tool for later work and study but also

- enrich children's aesthetic and linguistic experience;
- provide children with the means of exploring their environment;
- develop powers of logical thought.

The practical and intuitive experience which should be the result of a curriculum of this kind provides an invaluable base for further work in the secondary years. However, the study of mathematics in the primary years should not be seen solely as a preparation for the next stage of education; time spent on mathematics should also be seen as worthwhile in itself – time during which doors are opened onto a wide range of experience. Mathematics should be presented as a subject both to use and to enjoy.

Teaching style

It is not possible to indicate a definitive style for the teaching of mathematics; approaches to the teaching of a particular piece of mathematics need to be related to the topic itself and to the abilities and experience of both teachers and children. Furthermore, methods which may be extremely successful with one teacher and one group of children will not necessarily be suitable for use by another teacher or with another group of children. Nevertheless, there are certain elements which need to be present in successful mathematics teaching to pupils of all ages. Mathematics teaching at all levels should include opportunities for

- exposition by the teacher;
- discussion between teacher and pupils and between pupils themselves;
- appropriate practical work;
- consolidation and practice of fundamental skills and routines;
- problem solving, including the application of mathematics to everyday situations;
- investigational work.

This list is not new. The method of working which it describes has been recommended, in one form or another, over many years. However, although there are some classrooms in which the teaching includes, as a matter of course, all the elements which are listed above, there are still many in which the mathematics teaching does not include even a majority of these elements. The implications of this fact are considerable. It is essential that standards of mathematics teaching should be improved overall. The extent to which this is accomplished will depend in large degree on the extent to which those who teach mathematics are able – and can be helped – to work in the way advocated above.

Practical work

Practical work is essential throughout the primary years if the mathematics curriculum is to be developed in the ways advocated in the previous paragraph. It should encompass work on shape and space, graphical work, logic and the activities of daily life such as shopping, travel, model making and the planning of school activities, as well as measurement and number work. Work of this kind requires a considerable amount of time but, provided the work is properly planned and followed up, this is time well spent. For most children practical work provides the most effective means by which understanding of mathematics can develop. It enables them

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*Use of mathematics by adults in daily life. ACACE, 19B de Montfort Street, Leicester LE1 7GE.

to think out the mathematical ideas which are contained within the various activities they undertake at the same time as they are carrying out these activities. It is a mistake to suppose that there is any particular age at which children no longer need to use practical materials or that, as children grow older, such materials are needed only by those whose attainment is low; even children to whom abstract thinking appears to come easily often need to undertake practical exploration at the beginning of a new topic.

Use of language

Language plays an essential part in the formulation and expression of mathematical ideas but in many schools it is not accorded sufficient prominence during mathematics lessons. From their earliest days at school, children should be encouraged to discuss and explain the mathematics they are doing with their teacher and with their fellows so that, by means of this discussion, they can share their ideas and develop and refine their understanding. The development and extension of mathematical language should continue throughout the primary years. Teachers need to be aware of the great variety of language which is used in connection with many of the mathematical operations which children will meet so that they can assist their pupils to become familiar with the many different ways in which the same mathematical idea can be expressed. For example, the instructions 'add 5 and 3', 'add 3 to 5', 'find the sum of 5 and 3', 'find the number which is 3 more than 5' all require the same mathematical operation to be carried out. Children need to be able to interpret these apparently different instructions and to attach them all to the symbolic form 5 + 3.

Reading skills in mathematics should be built up alongside other reading skills so that children can understand the explanations and instructions which occur in the mathematics books which they use. It is a mistake to try to avoid reading difficulties by preparing work cards in which the use of language is minimised or avoided altogether.

Calculation

The focussing of attention onto standards in schools which has occurred in recent years has created pressure in some quarters for a 'back to basics' movement – pressure which has sometimes been heavy on those who teach in primary schools. This has encouraged some teachers to restrict their teaching largely to the attainment of computational skills. However, the ability to carry out a particular numerical operation and the ability to know when to make use of it are not the same; and both are needed. The mathematics of everyday life, as well as the mathematics used in employment, is always mathematics used in a practical situation. It is based largely on measurements of many kinds made for many different purposes. Arithmetical skills are therefore a tool for use in situations which require an understanding of other areas of mathematics such as the geometry of shape and space and graphical representation of various kinds. An excessive concentration on the purely mechanical skills of arithmetic for their own sake will not assist the development of understanding in these other areas. It follows that the results of a 'back to basics' approach are most unlikely to be those which its proponents wish to see, and such an approach can in no way be recommended. Nevertheless, children need help and practice to develop appropriate skills of both mental and written computation. These skills are founded on basic concepts which need to be developed through measurement, shopping, the use of structural apparatus and many other activities, and which include the meaning of the operations of addition, subtraction, multiplication and division as well as the very important concept of place value.

Mental calculation

The decline of mental and oral work within mathematics classrooms which has taken place in recent years reflects a failure to recognise the central place which working 'done in the head' occupies throughout mathematics. Even traditional methods of recording calculations on paper are usually based on steps which are performed mentally. For example, the written calculation 27 + 65, carried out by the method which is traditionally taught, requires the mental calculations 7 + 5 = 12 and 1 + 2 + 6 = 9. A still more important reason for including the practice of mental calculation is the now well established fact that those who are mathematically effective in daily life seldom make use 'in their heads' of the standard written methods which are used in the classroom but either adapt them in a personal way or make use of methods which are highly idiosyncratic. It is, for example, common when carrying out calculations mentally to deal with the hundreds or tens first and the units afterwards; for instance, when adding 27 and 65, to use the sequence 20 + 60 = 80, 5 + 7 = 12, 80 + 12 = 92 – but this is, of course, only one of several methods which can be used to carry out this calculation mentally. Although many children come to realise by themselves that methods which may be convenient on paper are often not well suited to use 'in their heads', many others do not; and so their teachers need to point this out and to discuss at length the variety of methods which it is possible to use.

Approaches to calculation

It is not the case, as is sometimes alleged, that teachers in many primary schools pay insufficient attention to developing computational skill in their pupils. Indeed, the report of the HMI Primary Survey states that in some classes pupils were spending too much time undertaking repetitive practice of processes which they had already mastered. However, it is essential that children should be helped to attain a secure and rapid recall of number facts up to 10 + 10 and 10 × 10. This knowledge, together with an understanding of place value, provides a basis for calculations involving small or large numbers. The learning of these number facts needs to be based on understanding but understanding does not necessary result in remembering. A time comes, therefore, when most children need to make a conscious effort to commit these number facts to memory. However, there are some children who will not have acquired such secure and rapid recall by the age of 11.

Young children should not be expected to move too quickly to written recording in mathematics. Some parents, albeit with the best of intentions, can exert undesirable pressure on teachers of infants to introduce written recording of mathematics, and especially 'sums', at too early a stage because they believe that the written record is a necessary sign of a child's progress. However, there are many stages through which young children need to pass in order to carry out written calculations with understanding. A premature start on formal written arithmetic is likely to delay progress rather than hasten it.

Calculators and computers

There are two fundamental matters which need to be considered:

- the ways in which calculators and micro-computers can be used to assist and improve the teaching of mathematics;
- the extent to which the availability of calculators and computers should change the content of what is taught or the relative stress which is placed on different topics within the mathematics syllabus.

Both of these matters are relevant to the work of primary schools.

Many teachers in primary schools feel some uncertainty about introducing calculators into their classrooms until more guidance is available than is the case at present. However, it is important to realise that the availability of a calculator in no way reduces the need for mathematical understanding on the part of the person who is using it; and the evidence from research studies is that the use of calculators has not produced any adverse effect on basic computational ability. There is as yet little evidence about the eventual balance to be obtained at the primary stage between calculations carried out mentally, on paper or with a calculator. However, it is clear that the arithmetical aspects of the primary curriculum will be affected by the increasing availability of calculators, not least in the home; for example, children who make use of calculators are likely to meet decimals and negative numbers earlier than is usual at

ACTIVITIES FOR BUILDING MATH VOCABULARY AND CONCEPTS

Pat Lawrence

The students of Mrs. Ann Metcalf in Dalton Foljambe Infant School were practising math without a textbook or worksheet. This was the general teaching method found throughout all the elementary classes I observed.

One group of eight students with headsets was listening to a teacher-prepared taped set of instructions, placing plastic pegs of various colors into a counting board which is numbered across the top. (Junior Counting Board by Reticle, from Sutcliffe Ltd.)

For about ten minutes students attentively followed directions such as these;

a) find #10; put a white peg in 4 more than 10
b) put a blue peg in 2 more than 6
c) find #17; pick up a yellow peg; put it into 2 less than 1
d) ... into 4 more than 30
e) ... into 38 increased by 4
f) ... into 27 decreased by 6
g) find #51 and #59; put red pegs between 51 and 59.
h) find #91; put a row of white pegs in all numbers above 91 (...greater than 91.)

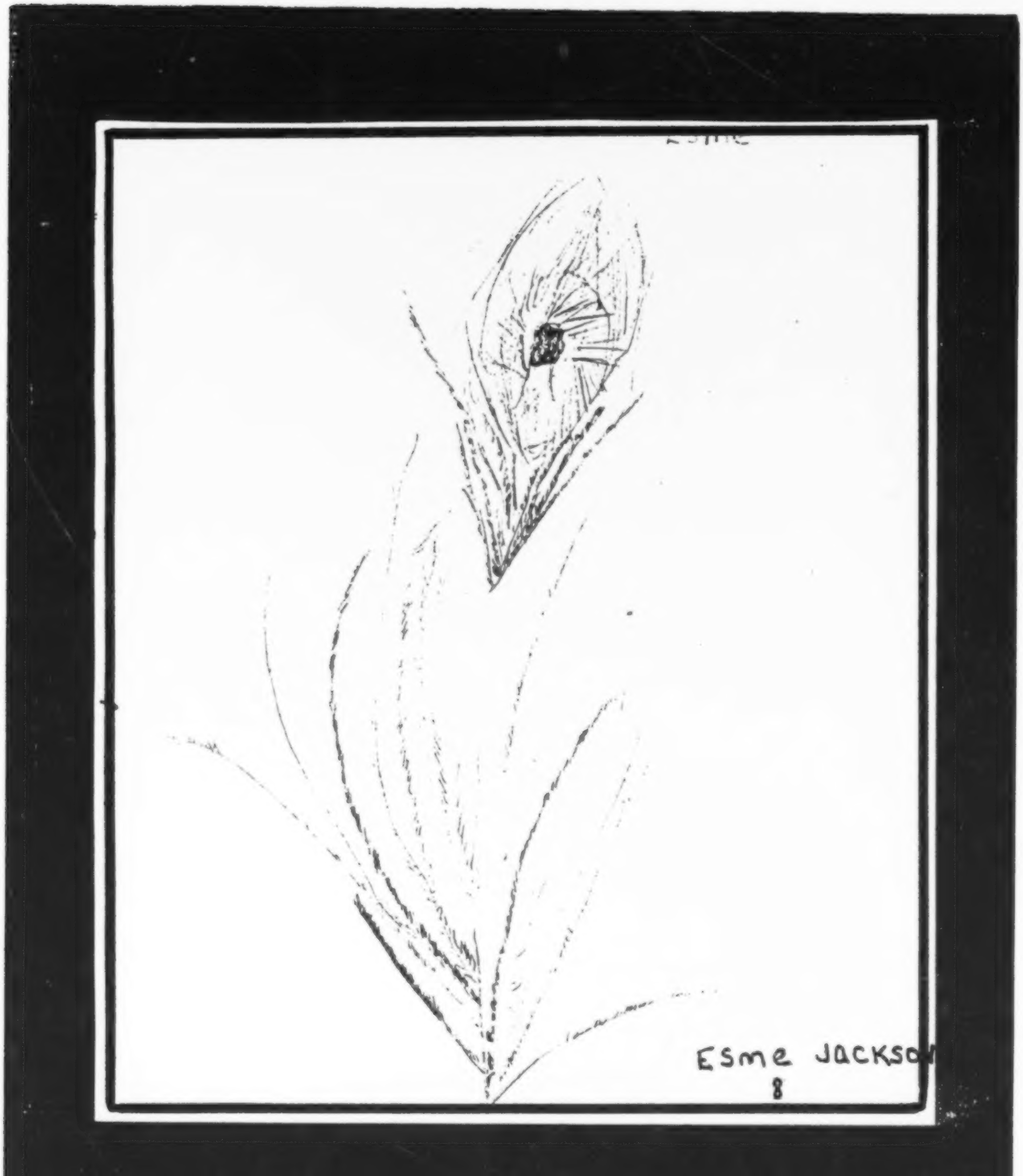
The benefits of this multi-sensory practice are many:

1) of foremost importance are the listening skills, learning to attend to and remember a series of verbal directions
2) reinforcing discrimination of color, number, place value
3) counting, building concrete experiences in addition and subtraction, practising the basic facts
4) understanding the vocabulary "more than, less than, increased by, decreased by, between, greater, less," or any that the teacher may wish to build upon

How was the work checked? Various ways. First of all, there was peer-checking. The students kept an eye on each other's work for reassurance and mutual admiration. Some discussion occurred as the tape played. Differences of opinion were not always resolved, but repeating the directions to others helped clarify them for students. Students could also replay the tape at the end.

The group was then asked to draw a map of their completed board. With crayons they put colored dots on a paper grid matching their results. These could then be compared to the teacher's map. Another checking device would be to list all the numbers with each pegs color. Each of these follow-up procedures uses another important math skill--that of reporting findings in a graphic way.

In this kind of activity, each student has some opportunity to use his own best learning mode. The children can work at their own pace, repeat at will, and the teacher is free to observe or work with others. Big returns on a little time taken to make the tape! In the British schools students are given the tools to manage their own learning!!



THE NELSON HANDWRITING SCHEME

Judith K. Hall

One handwriting scheme used in Sheffield, England is the New Nelson Handwriting series. The exercises in this series of six books are organized to help teacher structure the formal teaching of handwriting for ages 5 to 11. The major goal of whatever scheme is used is legibility, and children are urged from the beginning to develop their own particular style.

The new Nelson Handwriting differs from series such as the Palmer Method used in the United States in that there are no prerequisite strokes presented and practiced prior to the introduction of a letter's formation. In addition, when the transition to cursive (joined writing) is made, there is very little slanting of the letters. Moreover, the children are encouraged to develop their own legible style rather than conforming to the style demonstrated in the book.

At age five, (and sometimes even earlier) the child is shown how to form a printed letter, traces teacher made or book examples, copies the letter below those examples, and eventually transfers that letter onto a different sheet of either lined or unlined paper. The coinciding sound for that letter is introduced simultaneously. As more and more letters are introduced, students might describe an object to the teacher who then writes down the description. The child would then trace the words, copy them below the ones traced and then transfer the words onto another sheet. At other times the same procedure would be followed with a group of words or sentences from the handwriting book.

By the time the children are eight years old, emphasis is put on printing on lined paper correctly, as well as the correct usage of capitals, punctuation, grammar and sentence structure. They are still printing in pencil and encouraged to print legibly and develop their own style rather than trying to conform to a book's style.

Nine year olds begin joined writing (cursive), which resembles printing except that letters are connected. They continue to write straight up and down with very little slant given to those letters. The same procedure for the teaching of printing is used to introduce joined writing. At this time, students begin using ink.

So, at a very early age, children are tracing, copying and recopying sentences they have dictated to their teachers. Eventually, the students begin to write their own sentences. Finally, the student is able to construct and legibly write compositions in a hand resembling italics or calligraphy.

The children are able to reach that point easily because they have many opportunities to write daily. Whether it be working exercises or creative writing, writing is an integral part of the curriculum used in virtually every subject area. Samples of their work are displayed throughout the school. These samples are extremely neat, legible, and interesting to read.

GIFTED EDUCATION METHODS

Sandy Kinder

In the spring of this year, I was hired to be the teacher of my district's third grade self-contained gifted class. I had taught in the K-6 gifted pull-out program for a number of years while teaching my regular class, so teaching the gifted class was not going to be a completely new experience for me. On the other hand, having 20-25 gifted students all day, every day during the school year, was. I began to think about how I was going to set up my new classroom to meet the needs of my new students.

Now that I'm back from England and have completed all my gifted coursework, I can see many similarities between what I observed happening in the British schools that have also been proven, with research to back them, to be effective methods with gifted students. Torrance (1978), Guilford (1967), Treffinger (1978), Williams (1969), and Renzulli (1977) suggest that divergent thinking and creativity in problem solving should be encouraged in gifted students. These researchers also found that students should be taught how to analyze and adapt ideas into workable solutions. Some suggested that students should be using the discovery method and be actively researching their own interests. In addition to the importance of creativity and the teaching of problem-solving, the role of the teacher as a guide and facilitator is emphasized as very important to the growth and learning of each child. These elements show up strongly in the British schools to which I was assigned.

I observed in two elementary schools and one secondary school for one week in and around Sheffield, England. The two elementary schools were physically different in that one was open space and the other was self-contained, but both were similar in philosophy and approach. Both had the following characteristics: a child-centered environment, small group and individualized instruction, the teacher's role was more as a guide than instructor, few textbooks, integrated subjects, stimulating atmosphere, children making many decisions about their learning, emphasis on creativity, lack of report cards and grades, children pursuing their interests through their own learning style, real life problem-solving, and math understanding through use of many types of manipulatives.

In a class of 10-11 year olds, I observed how most subjects were integrated. The class had just returned from a field trip and the children were working on different projects when I entered. Each child had chosen whatever activity they wanted to do. Some were writing stories, poems, or reports about the trip (language arts), two others were making a paper mache model (art), others were drawing sketches (art), one was using a map and calculating mileage (math and geography), another small group was researching the animal and plant life of the area they visited (science), others were making a clay sculptures (art), and one was writing about the occupations involved in the trip (social studies and language arts). They were not using textbooks, but there were many other books in the classroom being used as resources and references. The children were involved in decision making so far as the issues they engaged and they were doing the projects in the learning style and at the level that they felt comfortable and confident.

I saw the integration of subjects in the majority of the classes I observed. Reading, spelling, handwriting, writing, and grammar were parts of a whole. I did not see separate textbooks for these. One teacher could not understand how we could teach spelling as a separate subject and have all students with the same list. Many children would be practicing words they already knew how to spell, she said. And many would be dealing with words which had no meaning for them. What words did her children study? The words they missed as they were writing sentences, stories, poems, and projects. In another class of younger children who were learning to read and write, the teacher was writing a child's story on a piece of paper as the child told the story in his own words. The child would then copy the story from the teacher's copy, read it, and then illustrate it.

Many teachers had different areas set up with different activities and children for the most part chose what area they wanted to work in. Teachers might make suggestions or ask a student where he or she might need to work, and rarely (if ever) was the teacher directive. Teachers did not record grades but rather checks for tasks completed. One teacher, fair enough, remarked that it was difficult at times to keep track of all the students' activities during a day.

Creativity was outstanding in the schools I saw. Most of the students seemed to be above many of the students I've had in the areas of creative writing, art, problem-solving, manuscript handwriting (cursive writing was not formally taught), and geometric design. I think this can be attributed to the emphasis on creativity and the supportive climate provided for each child from the time they enter school. Both buildings had children's work covering the walls on table displays in the classrooms, in the halls, and throughout the school. While leading the daily assembly, the head teacher (principal) would read student's stories, poems, and reports, show their art work, have students perform musical pieces, and congratulate the students who had solved problems at a problem-solving table that he had set up in the hall. He acknowledged the student and their accomplishments, thus building each child's self image and encouraging that student and others to be creative in their own way.

Children are given the opportunity to make many decisions about their own learning and thus they are somewhat advanced in problem-solving and in making judgments in new situations. They are allowed to investigate and discover many issues for themselves. In math they use manipulatives like Cuisenaire rods, attribute blocks, counters, array boards, geoboards, sticks, bottle caps, peg boards, and many others that allow children to see and understand patterns, relationships, and operations. In one small group, the children used different methods to get to the same answer for a problem presented to them by the teacher. It was noted by the teacher that all methods were correct but that some could have been quicker. They discussed these and other ways to solve this problem. There was no "one right way" to solve the problem.

The children seemed less inhibited and freer to express themselves, not only in creative writing but in art and body movement. Quite often, they carry sketch pads and pencils. I observed one teacher talking to a student about his sketch work. She asked him to see if he could find something in the still life in front of him that no one else might see and he was thus encouraged to be more observant and more detailed in his drawing. Artwork was expressed in many forms and viewed materials - paintings, geometric designs, three dimensional designs, sculptures, models, exhibits, collages, dioramas, paper mache, pen and ink, quick sketches, etc.

Manuscript writing was an art in itself. In one building, the children even used calligraphy chalk and pens. The children started printing with an overprinting method and are never really taught cursive writing. The children just eventually start connecting their printing. I also noticed that many of the adults used this connected printing. Not only was the writing beautiful but the content showed much imagination and freedom.

In "movement" (i.e. P.E.), body movement class even ended with children developing their own routine. Complex creative activity for each individual, not from the teacher but from the kids!

On the whole the British methods went along with gifted education's philosophy of leading and guiding the students and then letting them go. This could explain why gifted education is not as strongly needed in Britain. Most schools do not have academic ceilings and students are encouraged to go as far as they can.

Now that this school year is ready to begin, I feel that the coursework and research in gifted education, along with the observations in the British schools, plus the 16 years of experience I've had in the regular classroom will allow me to establish a more creative and challenging classroom environment that meets the needs of my students.

CHILDREN'S ART

Nancy Sweet

The first thing a visitor notices upon entering the British schools is the fantastic artwork. It is simply overwhelming -- lifesize characters on bulletin boards and painted on windows, brilliant colors on mobiles hanging from ceilings, and all wall space covered with drawings and illustrated stories.

Closer examination of art projects reveals that students incorporate art in nearly all lessons, even mathematics. For example, one class of second year juniors (equivalent to our fourth grade) had studied Mayfield Valley, a nearby historical community. A culminating activity was a visit to the location. While there, the children sketched the buildings and plotted out geographical contour maps, thus utilizing math concepts extensively.

Another day I observed two girls in a first level juniors (equivalent to third grade) who were working together on a project. They had gone out to a garden area of the school and picked a rose. At their desk they first wrote a paragraph describing the rose in great detail -- its color, texture, smell, etc. Along both sides of the paper they had drawn a border of twining roses in remarkable detail. Then they began to break the rose apart. As they did so, they continued to write a description of what they were discovering about the rose--shape of individual petals, the difference in texture of the rose petal at the outer edge as compared to the part near the center, the stickers on the stem, etc. In addition to the written descriptions, they added sketches on the rose's various parts.

Even very young children, some only four years old, were producing vast amounts of artwork. All available space in the building is used for hanging artwork (including the ceiling). Paintings and other drawings and creations were fastened to the ceilings in rooms and halls. In addition the children appeared to work in groups on many of the projects, especially the large three dimensional dragons and serpents that were displayed. I saw no dittoed or reproduced pictures for the children to color nor did I see any patterns being used. However, I did see children with photographs. For example, one girl had a book with a full page photograph of a Bengal tiger. She was painting on a large 24 x 24 sheet of paper from the photograph. THe next day I went back to look at the completed picture and it was unbelievable well executed. I talked with the teacher briefly. (There are no "special" teachers for anything -- art, music, P.E., etc.) She said that the children had spent a considerable amount of time on proportion and had even made self-portraits (to scale) of themselves. As the "rose investigation" above combined science and writing, here we see children combining math with art.

In general, the children are very proud of their work and very eager to have it displayed. The schools are very much a place for kids!

A CARD GAME TO PRACTICE SUMS UP TO TWENTY
Pat Lawrence

On small cards (half of a 3 by 5 card) write the numbers from 1 to 19. Make 4 or 5 sets of these and laminate for durability.

For 3 to 5 players. Give all cards out, face up.

Player #1 plays his highest number. Player #2 plays a card on the first, trying to get close to the sum of 20 without going over. Next player does likewise; if unable to play on first card without going over, player must start a new stack with his highest card. Play continues until all cards are used.

Object: Player who can make the sum of 20 exactly keeps that stack of cards. Winner is the player who takes the most cards.

Lots of review on those 'teens' as constant re-adding and checking is required here. Self-monitoring.

TITLE SORTING: MULTIPLES OF 2; OF 3; COMMON MULTIPLES

First Child: Sort out all the numbered tiles which can be counted by 2s.

Second Child: Sort out all the numbered tiles which are counted by 3s (or are divisible by 3, or have a factor of 3.)

Both Children: Place all the tiles you sorted out into Venn loops (big plastic circle frames) to show in which sets the numbers belong. Overlap the loops to hold any numbers that are in both (the intersection of the sets). Take out the duplicates and name them in order. What can you say about those?

VARIATION: Start with two loops; put all the counting-by-two tiles in one circle, and all the counting-by-three tiles in another. What happens? Overlap the circles to hold those numbers that are shared or needed by both sets.

Follow-up: Draw a picture of your results to keep in your maths journal.

British Eyes on American Mathematics

By DAVID LINGARD, Northcliffe Comprehensive School, Conisbrough, Yorkshire DN12 3JS, England
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During the summer of 1984, the Teachers' Center Project of Southern Illinois University at Edwardsville (SIUE) sponsored three-week-long courses for teachers. The sessions, funded by the Jessie Smith Noyes Foundation, took place at California State University—Fullerton, the Boulder Valley (Colorado) Public Schools, and Southern Illinois University. The course leaders were David Lingard, head of Northcliffe Comprehensive School, Yorkshire, England, and Sylvia Johnson, former mathematics chairman at Northcliffe and research officer for the Department of Education and Science in London, now a teacher educator at Sheffield City Polytechnic Institute. Both Lingard and Johnson are active in the Association of Teachers of Mathematics, the British counterpart of NCTM. Thomas C. O'Brien is a professor and director of the Teachers' Center Project at SIUE.

Thomas C. O'Brien: During the thirteenth annual summer course of the Teachers' Center Project we have had the opportunity to have David Lingard and Sylvia Johnson with us from Yorkshire. One of the things that I would like to ask them to address is the commonplaces that we have in American education, the things that we take for granted. Maybe two pairs of fresh eyes can help us to see things that we have not seen before. Also, I'd like them to talk about the differences between what they've seen of mathematics education in the U.S. and what they know of mathematics education in the U.K. In this way, perhaps we can learn a bit about ourselves and about other people's views of teaching and learning mathematics.

> Mathematics is seen as an integrated subject. It is the teacher's job to try and make sure that the children understand what they are doing, not the pupil's job.

David Lingard: There are a lot of immediately obvious differences. One major difference is the fact that in England we teach mathematics to children from kindergarten age through to the equivalent of twelfth grade, whereas in America, particularly in the high schools, it seems that arithmetic, algebra, and geometry are taught as separate courses. The first time I came to look at American mathematics teaching two years ago, I was astonished to find that a student could spend the whole year in mathematics doing nothing but arithmetic or nothing but algebra. That simply couldn't happen in England. Mathematics is seen as an integrated subject.

Sylvia Johnson: One of the other big differences is that it seems to be laid down that a child of age eight ought to be able to do this and a child of age nine ought to be able to do that. In English schools, there is much more of an acceptance that different children of the same age will have very different abilities, and what is appropriate for one child might not be appropriate for the next child.

David: Going back to the algebra, geometry, and arithmetic issue, one noticeable difference is the almost total absence of geometry from the high school curriculum and the concentration on arithmetic and algebra. A number of high school teachers have said to me that they only do geometry if they've got time left when they finish the algebra and arithmetic and that geometry is given scant attention. To particularize, I understand that the Pythagorean theorem is usually taught in tenth grade because that is when the geometry course comes, if at all. In England, the Pythagorean theorem is often taught in seventh or eighth grade, together with a lot of other geometry. You could argue that it does not really matter when it is taught, but as a good deal of mathematics is dependent upon the use of the theorem, then if you have not done it before tenth grade, you're preventing kids from making progress in some areas of mathematics.

Tom: Can I back up a moment? I think it may be wise to explain briefly what you mean by geometry. To us geometry means the tenth-grade course with lots of theorems to prove. Given the week that we've been through at SIUE, is it fair to say that you're interested in visual relationships?

David: Yes, essentially, I think what we're trying to do with most kids in school in England, as far as geometry is concerned, is to develop spatial ability. The fact is that we live in a three-dimensional world, and kids are experiencing geometry all around them every day. I think it's our job to help kids be aware of that. Another reason is that geometry can be so illuminating to the algebra and arithmetic. We had one example this morning. We were looking at the differences between the squares of consecutive integers,

$$7^2 - 6^2 = 13,$$
$$8^2 - 7^2 = 15,$$

and so on. And Shirley Casey [formerly with SIUE Teacher Center] made the point that it was not until she saw a geometric representation of the issue that she really understood why the difference between the squares was always going to be odd. We've had many other examples during the week where the geometric representation of a particular situation in arithmetic helped people to understand what was going on. I think mathematics teachers ought to be looking all the time for ways of supporting what they are saying and getting kids to look at things in different ways. Very often geometry helps kids to do that.

Sylvia: There's another very big difference, which must be quite a conflict for American teachers. I'm sure American teachers care a great deal for their pupils, but there seems to be more of a genuinely pupil-oriented approach to the whole of education in England than there is in America. And that goes right through to the extent that the level of communication among teachers in English schools seems much higher. For example, in my department in England we would talk about the kids we were teaching and how they got on with this or that part of the curriculum, what mistakes had happened, and what hadn't gone well with this or that child. As a department we would talk about what grades we were going to award. We would meet as a department and discuss all these things. That seems to be almost vetoed in American schools. It is not regarded as professional to discuss pupils and their work, whereas it is regarded as one of the professional responsibilities of a teacher to share the responsibility for the education of each child. I might talk to an English teacher about how a child I'm teaching mathematics to is getting on in English. That sort of thing just seems to be nonexistent here, from what I've seen.

> As a department we would talk about what grades we were going to award.

Thanks to David Lingard, who is head of Northcliffe Comprehensive School, near Doncaster, Yorkshire, England, and to Sylvia Johnson, who is now a teacher educator at Sheffield City Polytechnic Institute.

Tom: Any other differences that might be appropriate to mention?

David: There are lots of differences. Take the textbook issue. It is clear that in America, mathematics teachers use a book for geometry, a book for algebra, a book for arithmetic, and so forth, and that book will be used by all the teachers in a school and very often all the teachers in the district or even in the region. That is totally unknown in England. There are lots of books and pamphlets and home-produced material (produced by teachers themselves in their own schools or in their own homes) available to children. Teachers have considerably more freedom and responsibility in England than they do in America. There's just no question about that. As a mathematics teacher in England I can use whatever I like, providing it meets with the general approval of my head of department. On the whole I can choose whatever texts the school has available. As I say, most schools will have a variety of texts and pamphlets, equipment and apparatus, and home-produced material available to teachers and kids. I will be very eclectic about how I use these materials. I will pick this book because it has a good chapter on so and so. I will pick that book because it has a good chapter on such and such. And very often I will do my own material because there isn't a book with a good chapter on this or that topic at all.

Schools have a variety of texts and pamphlets, equipment and apparatus, and home-produced material available to teachers and kids.

Sylvia: Teachers here seem to feel that they have a course to teach, and they do that by going through the textbook. (In some cases we have met teachers who've said they use a wide range of things in addition to the textbook.) But it's still very much, "This is the course that we have to teach, and it is the pupils' responsibility to make sure that they understand the course." And so teachers will say things like, "I will set homework every night, and it's the kids' responsibility to do it. I will collect their books to make sure they have done the homework, but it's up to them to let me know if they understand or don't understand what they've done." In several situations I've seen, the teacher will not correct the books. They will just check that the work's been done.

That seems to me to be very different, professionally, from the role expected of a teacher in England. It is the teacher's job to try and make sure that the children understand what they are doing, not the pupil's job. And as a head of department, I would expect teachers in the department regularly to collect the books, mark them, check them sensibly (not just put ticks), and use that assessment of the kids' work in a diagnostic way, to follow up as to which individuals haven't understood, and to provide extra help as needed. It wouldn't be up to the kids to come as a group and say, "None of us understands this." Now in some cases kids will do that, and if a kid does come to you as a teacher and says, "I don't understand this," obviously you respond to that. But it's primarily your responsibility to look at what the kids are doing, to diagnose what's good and what's not good, and then to adjust your teaching accordingly.

Tom: Which gets us into the area of assessment. One of the commonplaces in U.S. education is the domination of tests. They are dominant. And they are externally produced.

David: Yes. That's very different. Just before I comment on that, let me go back to the textbook domination again. We talked about the proliferation of classroom material in England. Certainly one of the profitable developments in terms of education, not finance, that's happened in England in the last fifteen years has been the growth of teacher-produced material for the classroom. This is not just the individual teacher producing worksheets at home in the evening, but groups of teachers getting together to write materials for the classroom that are then made available to wider groups of teachers in various ways, usually in a nonprofit-making way, a cooperative way. There's been a considerable explosion of that style of working.

In England the first public formal external assessment takes place at the end of tenth grade. For the majority of kids this is the CSE [Certificate of Secondary Education] assessment. Teachers have the opportunity to control this form of assessment, that is, to write the syllabus, determine appropriate methods of assessment, and carry out the assessments. The Examination Board controls things administratively, moderates between schools and teachers to ensure that standards are maintained, and actually awards the grades. The grades are awarded on the basis of teacher assessment. Many teachers take advantage of this very real opportunity to control the assessment of their students.

A minority of kids, approximately the most able 20 percent, take a different form of external assessment at the end of tenth grade, leading to the General Certificate of Education [GCE "0" level]. Here there is more control by the Examination Board, but the pattern is changing, and increasingly syllabuses are including some form of school-based assessment.

Tom: You're talking about the "0" levels?

David: Yes. But interestingly this is all changing. In 1986 a new system of assessment is being brought in to replace both "0" level and CSE. The new system of assessment that will be used with the majority of tenth-grade students will again give teachers the opportunity to control the methods of assessment and to some degree syllabus content.

Tom: But if this is so, the obvious American question would be, "What about standards?"

David: Why is anybody suggesting that teachers who are professionals should not be able to determine the standards as well as anybody else? I mean, if teachers don't determine standards, who does?

Sylvia: I would like to raise here what I see as a myth in the so-called objectivity in the American system of grading. We have been told that teachers are often required to grade pupils every week, sending a grade home to parents. But we have also been told about the complete lack of communication among teachers about the grades awarded. So one teacher awards a grade A for work for which another teacher might award a grade B, and so on. The argument is that the nature of the work attempted determines the grade. Yet work can be done in a variety of ways to a variety of depths and assessed to a variety of standards. With no discussion among teachers, it seems that leaving the award of grades to one teacher is far from objective, nor can it ever be.

One can get the highest grade possible on an exam and have few right answers.

David: That's right. Where you've got teacher-controlled assessment in the schools, as in England, teachers have to meet. I have to go along with the other nine teachers teaching tenth grade and sit down and compare the work my kids have done with what their kids have done. Let's look at their work and compare and see if your grade B means the same as my grade B, and so on. There has to be what we call internal moderation, which means a lot of discussion and argument, and often soul-searching, among teachers working within a department to determine standards.

Tom: What's an example of a test question? Choose a level and give us an example of a test question that might be used with children in your school.

David: An example from a ninth-grade CSE examination paper—I'm picking a geo-

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British Eyes on American Mathematics

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metric one deliberately—went something like this. Here's a right-angle triangle. (There was a diagram of this triangle giving its measurements.) The first part is very straightforward. Calculate the area of the triangle. Then it said, "You could put some triangles like this together to make an equilateral triangle. Calculate the area of the equilateral triangle." Then it said, "Six of these could be put together to make a hexagon. Show how you could do this." Then it went on and said, "You could put a number of these hexagons together to make this flower arrangement (which was drawn out). What is the width of this arrangement? If you wanted to create a flower arrangement twice as wide, how many little triangles would you have to start with?"

Tom: And the way of reaching a response might differ very much from Johnny to Mary to Steven?

David: I think there would be some variation in that sort of question. There'd be a wider variation in other questions. For example, in a number-pattern paper that we used this year a question said, "Choose two numbers and write them down with the second larger than the first. Add them together and form a third number. Now add the second and the third number to form a fourth number. Now add your third and fourth number and form a fifth number, and so on." Then they were asked to take each pair of numbers in turn and divide the smaller by the larger and to comment on what they noticed. Certainly you get wide variation here because every kid might have chosen two different numbers to start with and kids would have approached the problem in a slightly different way and written a range of comments and explanations.

Tom: One of the commonplaces here in the U.S. is the multiple-choice test. Do you ever use multiple-choice tests? Do you always look at the child's actual work?

Sylvia: By and large, there are few multiple-choice tests. Most assessment is done by requiring pupils to write down solutions to problems, and teachers mark the solutions. One point here is that one can get the highest possible grade on an exam and have few right answers. How you approach a problem, how you tackle a problem, is given far more weight than the final answer.

> We permit the use of calculators during most examinations now.

We have discussed assessment of the sort of investigative work that David was talking about with teachers on our present trip. There might not be a single answer to a problem, and you can't just assess that sort of work by requiring correct solutions to a problem. That is a very, very big difference in approaches to assessment. The way students tackle something and the method that they use is of far greater importance than whether or not they get the right answer. You can make a simple arithmetic slip and get the wrong answer, and that should count minimally against you compared to your method of solution.

This does raise another issue. When we talked about devising a marking scheme that took into account the processes the kids have gone through—their methods, their work, tackling a problem—and allocating marks to that and not just to the solutions, teachers we met said that they weren't prepared to do that. It would take far too much time; they may have 120 scripts to mark, and they certainly weren't going to spend a lot of time doing that every week. Now that comes back down to the grading system and also to teacher continuity. We don't do it every week. We expect to mark like that every term or whenever the assessment is—maybe every half term—for one class of thirty kids. It would be unusual for us to have three or four classes all doing the same course at the same age level. So we wouldn't be in the situation where we had 120 scripts to mark, all the same, every week, to that degree of depth. There seems to be a Catch 22 situation here. If teachers are going to grade work not just according to whether or not the kids got the right answer, they're going to do it more thoroughly, and they can't be doing that for 120 kids every single week.

> It seems important that you teach through the ability range within the schools so that you have an idea of how kids progress. There is no way I can really assess a kid's work within half a semester.

Buried in all of this is another question, the question of who teaches what. Teachers must have a very boring life here if they teach four classes, all the same course. It would drive me batty. It seems important that you teach through the ability range within your school so that you have an idea of how kids progress. It also seems important to me that you keep kids for longer than—in some cases, we were told—half a semester. There is no way I can really assess a kid's work within half a semester.

David: Yes, there is no way that you can get to know children in that time when you're seeing them, say, three or four times a week and there are twenty-seven to thirty kids in the classroom, and so on. If I teach a ninth-grade class, I will certainly expect to see them all the way through ninth grade and all the way through tenth grade. In fact, in my own school we're moving toward a situation where we see kids right through eighth grade, ninth grade, and tenth grade with the same teacher for their entire mathematics course for three years. That's how you get better assessment of students' capabilities. The teacher gets to know the kids, gets to know their particular strengths and weaknesses, and builds up the relationship with the students. You know what they like doing, what they will worry about, what they will fear and back away from, and so on.

Just going back to what Sylvia said, to put it very hard-line, two or three teachers in Boulder actually said, when pressed, that yes, their main criterion for devising a method of assessment for students was, "Is it easy to mark?" In other words, could the teacher do the job pretty quickly or not? If they couldn't, then it was a bad test.

Tom: You disagree with that?

David: Sure! If you are doing a professional job and you are trying to assess students' abilities, then you've got to devise appropriate methods of assessment. Appropriate methods may not be ones that are necessarily easy for the teacher to mark. Going a bit farther on that, also in Boulder (but I suspect I would have got the same answer in California or Illinois), I asked about teacher continuity with classes. I asked why this didn't happen, and they said this was just how the schedule was arranged. I said, "OK, supposing I am a high school principal in Boulder and I say we're not going to do the schedule like that this year. I'm going to arrange that every mathematics teacher takes a class through for two or three years continuously. Are you saying somebody's going to stop me?" And they said, no, they didn't think anybody would stop me. In fact, Jim Robinson [Assistant Superintendent of Boulder (Colorado) Public Schools] said that it was up to any high school principal to take that line. So I said, "Why don't high school principals change things?" And the response I got to that was, "That's a good question!"

Tom: Let me build on that issue and ask you to talk about the role of the school principal, which you call a head teacher. What is the role of the head in your school?

David: I think I have two major roles. One of those is what I would call staff development, and the other is curriculum development. As to the first, the staff development, I think it's my responsibility to create a climate, an atmosphere, in which teachers can grow as well as one in which children can grow. Now there are all sorts of things you can do. You can simply suggest to teachers that they take opportunities for in-service training by going on this course or that course. That's one very obvious thing. You can support the teachers by working with them in their classrooms or covering lessons so they can watch other teachers working by arranging a departmental program for that opportunity to happen. I can do it by working with heads of departments who in turn work with their department to increase their professional skills. There are many ways in which a head can contribute to professional development of his or her staff. That is one of two major parts of my role.

The second part is the development of the curriculum for the children. That is an activity that is contributed to by all the teachers in the school. Departments have meetings to consider their courses and update them, change them, revise them, modify them, or shuffle them about in terms of what's suitable for what age groups. They devise new material; buy new material; find new equipment; try different things out; evaluate, comment, and discuss them; and so on. That's a process that is going on in our school all the time in every department, and it's something that, as head, is part of my job to make sure is happening, to create an environment in which that does happen, and to help people want it to happen. . . . Can we talk about problem solving?

Tom: Yes. It's one of the big issues in the United States. Problem solving is a widely used word these days, but to American mathematics teachers problem solving largely, no, not largely, almost universally, means word problems: "Three birds sat on a fence. One of them flew away. How many birds are left?" They amount to computational exercises couched in words. One straightforward question, do you do word problems in your curriculum at the primary and secondary levels?

Sylvia: Well that isn't what we mean by problem solving. We do use word problems, though not in the same way as you do here. They are used particularly with lower-attaining pupils as an introduction to interpreting mathematical situations presented in words.

> There is a danger that problem-solving courses will be put alongside algebra courses and the two will not be seen as related.

David: Problem solving, as we use it, is often more open and often more investigational, although not always so. Very often the sort of problems we're talking about are ones where there is no immediately obvious way of doing them. A couple of months ago we were talking with David Fielker [former editor of *Mathematics Teaching* and director of the Abbey Woods Maths Teachers' Centre], and David suggested that a problem was only a problem when you didn't have the solution. If you had a solution you didn't have a problem. Now that obviously doesn't hold water entirely as far as working with kids is concerned, but I think it's quite a nice way of putting it. Suppose I take two right-angled isosceles triangles, put one on top of the other in a certain way, and say, "What is the area of the intersection of the two triangles?" That's a problem. I can't solve it immediately. I don't know the answer. I don't know how I'm going to start until I get into it. I would call that a problem. You can't look at that and say, "Ah, yes. The way to tackle this is to use such and such a strategy." So your first problem is, "What bits of mathematics can I use here?"

Sylvia: There seems to be a growing awareness in America of what we would call problem-solving skills. And there seems to be a danger that these are going to get diverted into problem-solving courses where we have five lessons on finding all the permutations, five lessons on using tabulation, and then five lessons on drawing diagrams, rather than an integration of these abilities into the mathematics that you are doing. Quite a number of teachers we've talked to have seen problem-solving techniques as something very different from the mathematics they are teaching. It seems very important at this time in America that it doesn't get separated out. There seems to be a very big danger that schools are going to start putting problem-solving courses alongside their algebra courses and the two will not be seen to be related.

David: That just wouldn't make any sense to us at all.

Tom: This week we practice drawing diagrams, next week we practice coming up with a conjecture, the next week we practice some other isolated aspect of problem solving. There is a danger, yes. From the course that we've been through, can you recap and come up with some good examples of problem solving to illustrate what problem solving involves?

David: I don't know where to start. OK, there's one on the chalkboard that came up this morning that begins $6 = 1 + 2 + 3$, $9 = 4 + 5$, and so on. What other numbers are sums of consecutive numbers? $9 = 2 + 3 + 4$. What numbers can't be made like this? Find the numbers that can be made in four ways or five ways. And how many ways can you make 2342?

Tom: 9 can be decomposed into two consecutive numbers. 6 can be decomposed into three consecutive numbers, $1 + 2 + 3$.

David: And 15 can be decomposed into $7 + 8$, $1 + 2 + 3 + 4 + 5$, or $4 + 5 + 6$. And I think I'm right that if you check 105, it can be decomposed in seven different ways.

Tom: There's some orderliness happening here perhaps. Can you test that orderliness? That's what the problem calls for?

David: Yes. And can you generalize it? In other words, if I give you a number, can you tell me how many ways you can decompose it into consecutive numbers?

Tom: Another problem that we dealt with this morning deals with the difference between two consecutive squares, for example, 8 squared minus 7 squared. 8 squared is 64 and 7 squared is 49. 64 minus 49 is 15. 8 and 7 add up to 15. What's going on here? Does this always happen? Can you show geometrically that this always happens? Can you show it algebraically? Can you relate the two?

Sylvia: We could extend that particular problem. What happens if the numbers are not consecutive but, say, consecutive odd numbers or consecutive even numbers? So it's 8 squared minus 6 squared and 9 squared minus 7 squared.

David: Problems often lead to other problems that children invent. One of the advantages of working with children like this is that it allows them to be creative and to see mathematics as a creative activity, not as a subject that exists and has always existed and will never change and has stopped developing.

Tom: "It's in the books and somehow I have to get it into my head." That's not the sort of thing you're talking about.

David: No, it's not.

Sylvia: It's also accessible to a wide range of abilities within one room, in that a lot of problems of this sort have within them problems for the least able kids and problems for the most able kids. And it's therefore quite appropriate to do them with a class of a particular age group and engage all kids despite their varying abilities.

David: Can we switch topics? Just looking around the room I'm reminded of the things that we've been doing this week. You started out by asking what are the noticeable differences between mathematics teaching in America and in England. In the last five days we have used dominoes, counters, cubes, geostrips, dice, scissors, and about ten different sorts of paper, including spotty paper in many different forms.

Sylvia: Geoboards.

David: Geoboards, pinboards, pegboards, sticks, applicator sticks, and so on. And that's just in five sessions with a small group of teachers. All those things that I've mentioned, together with a host more that are around this room at the moment, are part and parcel of any good mathematics teacher's cupboard in the classroom in England. If I took you into any mathematics classroom in my school at home, you would find all those things readily available.

Tom: And yours is secondary school.

David: That's sixth to tenth grade.

Sylvia: And they're used with tenth-grade kids.

David: Suppose I say to a student, "I want you to picture taking three cubes and sticking them together face to face. How many different ways can you do that?" With three cubes the good student will be able to visualize that and sketch it. But if I say, "OK, now take five cubes and stick them together in as many different ways as you can face to face," even the most able students will not cope without actually getting the cubes and sticking them together, looking at them, turning them around in their hand, looking at them from different perspectives, putting them on the table, and comparing different models. The use of materials and apparatus pervades good mathematics teaching.

Tom: American education has been influenced very heavily by the back-to-basics movement. What have you seen here? What is taking place in England?

Sylvia: It is certainly apparent that elementary school teachers here are being required to teach arithmetic operations to pupils that in some schools in England have completely disappeared. Some teachers have talked about having to teach fifth and sixth graders division by three-digit numbers. They're required to do that. There is not a single teacher at Northcliffe who is required to do that with any of their kids because that seems to be an outdated operation. We permit the use of calculators during most examinations now. Students are allowed to use a calculator for some of their papers, and many arithmetic routines that we used to spend a lot of time on are dying out. Logarithms appear on very few papers now, and schools who are still teaching them are being encouraged just to drop them because it's an outdated way of working (unless you're talking about the most able people who might go on to logarithmic theory). But it's certainly true that the level of arithmetic skills that is expected here is way, way beyond what's expected in England. There has been in recent years a slowing down, if you like, of expecting children to master certain arithmetic skills. Even elementary teachers now are questioning whether or not they ought to be trying to do things like 2¾ multiplied by 4½. They just wouldn't touch that now, whereas I get the impression here that it is very much part of required curriculum, almost exclusively the curriculum. I sense the feeling that the more you practice these, the better off you will become. In England, there's been an awareness that that actually doesn't work. There are lots of things that even if we practice them everyday, we still can't remember them two days later. So why are we wasting our time? There are better things to do.

The Cockcroft report suggested more work on estimation and approximation.

David: Going on from there, surely the most interesting thing that has happened in a long time as far as mathematics education is concerned has been the publication of the Cockcroft report, *Mathematics Counts*. This is a result of about three years' work by a governmental committee.

What is interesting is to trace the history of that committee. About 1979 and before, there was growing—apparently growing—public dissatisfaction with the "standards" of school leavers in mathematics. A lot of the criticism was coming from industrialists, employers, politicians, and parents. The result was that the government set up a select committee of inquiry to look into that. And the outcome of that select governmental committee was to set up a committee under the chairmanship of Bill Cockcroft to investigate the teaching of mathematics in primary and secondary schools in England and Wales.

The Cockcroft committee met for three years or so and produced its report in 1982. The significant thing is that the report did not find, on the whole, any truth in the previous allegations that the mathematics that the employers said kids needed for work was not being covered by teachers, but they also found that a lot of mathematical skills that employers said kids needed for work were not actually needed at all.

We just talked about fractions. Here's a very short paragraph from the section on employers' needs from the Cockcroft report, part of paragraph 75:

> The need to perform operations such as 2/3 ÷ 3/7 does not normally arise [i.e., does not normally arise in industry and employment]. The manipulation of fractions of the kind which is commonly practiced in the classroom is hardly ever carried out. In the rare instances where it is necessary to multiply or divide fractions, it is usual in industry and employment to convert each to a decimal before performing the operation, if necessary with the help of a calculator.

That's just a small sample. What the report does go on to say is that what are needed and what employers do actually want are children who can think, children who can problem solve, children who can be creative, children who are able to sort out what mathematics is needed and what is not needed, what part of a problem is relevant and what part of the problem isn't relevant, and so forth. What they don't want are slaves and morons who act robotically.

Sylvia: The consequences of that report are beginning to be felt. In my work with five schools in my area, I find that the schools are addressing themselves to the issues of what "basics" they teach and how they are related to other things that they teach in the math curriculum. What use do they make of them? What context are they put in? What else could they do with the time that they used to spend on drumming in trivial facts? What are they not doing that they ought to do? What opportunities are they giving students for problem solving and for thinking activities? All that is certainly filtering its way down into schools.

Tom: Are substantial changes being made, do you think?

Sylvia: I think substantial changes are being made in certain areas, particularly in the production of new curriculum frameworks and assessment schemes. It will take a long time for teachers to develop new areas of expertise and the confidence to teach in new and more thoughtful ways.

Tom: How can one get a copy of the Cockcroft report?

David: People can get the actual report from Her Majesty's Stationery Office, 49 High Holborn, London WCIV 6HB, England. The cost of a copy is about eight dollars. The Association of Teachers of Mathematics (ATM) in England has produced a short summary of the Cockcroft report. It's a thin pamphlet that costs very little. It may be helpful to people who haven't got the time or the inclination to wade through the 300-odd pages of the original report.

Tom: And ATM's address is King's Chambers, Queens Street, Derby, DE1 3DA, England.

Sylvia: The cost is about ninety cents.

Tom: Can you briefly characterize the flavor of the Cockcroft report?

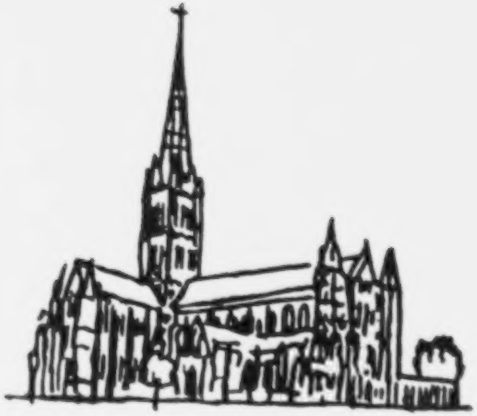
David: Let me quote from a page in front of me, which deals with estimation and approximation. "Although accuracy is important, so too is the ability to estimate and approximate which helps to insure accuracy especially if a calculator is being used." The report comes down heavily on the side of children's using calculators in the classroom—but enabling them and teaching them and helping them to use calculators sensibly. That requires a lot more work on estimation and approximation.

Sylvia: I think, too, that the overall flavor is one of stating very firmly that all teachers should be using a wide range of teaching styles, not just exposition. They should be allowing space for discussion. They should be allowing space for investigative work. They should be allowing space for problem-solving work. They should be thinking about pupil-teacher question-and-answer sessions. The report firmly states that we should encourage students not just to work with pen and pencil but to use both practical apparatus of the sort that David talked about and objects like scales and measuring devices.

David: The paragraph that Sylvia just referred to has become famous as paragraph 243. So if anybody's actually looking at the Cockcroft report, that's the one we're referring to.

Sylvia: One other major strand that I think needs mentioning is that the report heavily comes down on the side of slowing down and reducing the quantity but improving the quality. We need to cut some things out and make sure that kids better understand a smaller amount of work. We shouldn't rush through everything in elementary school, then rush through it all again in secondary school. We should span our curriculum over the years and not keep repeating things.

Tom: Very good. Let's invite people to look at, and to follow up with, the full report or the short summary available from the Association of Teachers of Mathematics. ■



The following quotation is found in the Chapel of St. Edmund Rich in the North Transept of the Salisbury Cathedral, Salisbury, Wiltshire, England. St. Edmund Rich was treasurer of the Cathedral 1222-1233 and later Archbishop of the Canterbury 1233-1240. He died in SOISSY in November 1240.

> "As you stand here remember those who have enlarged the horizon of your mind and pray for all who teach."

CHILD CENTERED SCHOOLS

Mary Lee Baumgartner

The elementary schools I visited in Sheffield, England, were definitely created and maintained for the students.

The children were talked to, not down to, by the head teacher, teachers, janitors, and kitchen help. The head treated the staff as he wished the staff to treat the students. Politeness, friendliness, and smiles were plentiful.

The students worked with books and occasional ditto sheets but they copied onto their paper what they thought to be important. The paper and the knowledge on it was theirs. The ditto was discarded.

Students did not complete the volume of work per day they do in American schools. (There is no "busy" work) Children's understanding of what they did was deep. The students worked toward a fine finished product--one worthy of display in the hall. This seemed to flow from their art work to creative writing. Art and music, the things that teach and help us to be human, were basic parts of these child centered schools.

Math in England did not revolve around a textbook. The teacher worked with small groups of five or six students. They toiled together to solve a math problem which related to some thing or event being studied as a unit. Student ideas were accepted and tried and students and teacher worked in a relaxed manner with much positive reinforcement was given. The correct answer was not stressed as being as important as the process used to determine the answer. Students had a definite grasp of what numbers meant since they had been working with manipulatives since nursery school.

Math was not set aside as a subject but was integrated into the curriculum through various units of study. One class had recently visited a lighthouse. They calculated the distance on a map and compared it to the actual miles. They also dealt with the building's dimensions, age, and probable cost. The math had meaning for the children since it involved something with which they were familiar. They in turn instructed their peers. By intermingling and rotating student groups and having the students teach each other, the teacher was able to work with all students in a small group setting each day. When their session was over, the students eagerly took their new knowledge on to other students.

PARENTING AND PRESCHOOL

Marion Whitby

> Marion Whitby runs the preschool program at Lynncroft Junior and Infant School, Nottingham, where John Dichmont is Head Teacher. Much of the program amounts to an educational center for parents and young children, said Marion. "Mums come with their children and all of them learn. ...Our youngest "pupil" was eleven days old. The program is a friendly, drop-in "home-away-from-home" for parents and children. Here are some of the notions which guide Marion's work.

However good a school is, it cannot override the influence of the home. A child's life chances and school chances are mostly determined by its parents. In our nursery we admit a fair number of children who, at an early age, lack confidence and interest in the world. Clearly, in such cases, the parents have not made a complete success of bringing up their young child.

It is inefficient to work only with the results of unsuccessful parenting. It makes more sense to go further back, and try to treat the causes of the problem in the first three years of the child's life at home.

This we can only do systematically and with any hope of success if at least one of our nursery staff is freed from work in the nursery with groups of children. Hence the need for an additional member of staff.

The overriding aim of the worker is to strengthen parent's belief in their own central role in their child's development from 0-5. This is by no means a straightforward task. The evidence available suggests both pitfalls and fruitful ways of working exist.

The failure of early intervention programmes that concentrated solely on the young child is well documented. Research in the last decade has shown the importance of involving parents in any programme designed to benefit children and has emphasized the need to reach the child through enhancing the skills and knowledge that the parents already have, increasing their enjoyment of their child and thus maximising their confidence in their own abilities and powers as parents. This shift from child-centered schemes to a family-based approach means that the parent, not the expert, is the primary agent of intervention. Work along these lines has already been well developed in some LEAS (Local Education Authorities) e.g., Coventry and Liverpool.

Traditional forms of parental education -- e.g., courses -- rely on and promote the image of the educator as expert. There is no evidence that this approach is effective. Parents will often pressurise professionals to provide answers. It is clear that, in this context, the task for the cooridinator is to enable the parent to work productively on their own problems. For this reason, the background and attitudes of the worker are crucial.

The worker is not to follow the model of the professional who knows, but to confirm or restore the parents faith in their own capacities to enjoy, develop and educate their child.

Evidence from other schemes strongly suggest that the experience of being a parent is very desirable, though not sufficient qualification; i.e., it is the experience of bringing up children and not that of being a teacher which is the proper basis for the exchange between parent and professional.

There is evidence that the second year of life is vital for parent-child interaction. There is frequently an increase in family stress as the baby becomes mobile. In practice, pressure of work means that health visitors may have to concentrate on the family only until the child is one year old. So there is a lack of professional help precisely when the crucial period of both parent and child begins.

One of the worker's main tasks would be to develop appropriate forms of action for mothers and children during the second and third years of the child's life.

Dangers

- others seeing this person as the solver of all problems for the parents of the under-5's.
- the worker absolving the nursery staff from their own responsibility and initiative for work with parents.

(To overcome this danger, the worker could, for example, enable the nursery teacher to visit a home rather than simply visiting the home herself; or free the nursery teacher to work with a group of parents).

Aims

To forge links between home, school and community; to support community initiatives and develop family-based approaches to the education of 0-5 year olds in the school's catchment area.

1. To help parents acknowledge their worth as educators of their child - to build up their confidence and make them feel valued.
2. To work with teaching staff and parents to promote greater understanding of school methods and philosophy - to introduce parents and staff where necessary to alleviate worries.
3. To help parents see the value and meaning of play activities, to advise on development and improve the quality of parenting.

4. To aim for an informal, friendly relationship, (not authoritarian) and to build up the trust of the parents.
5. To help parents and children enjoy each other and have fun.
6. To form links with the community and lessen the isolation of many families.
7. To encourage self-help among the community - to initiate schemes and projects to share knowledge and discuss problems.
8. To liaise with other professionals in creating a coordinated service.

2596 Scott Highton

BODY MOVEMENT CLASS

Sandy Kinder

I had the opportunity to watch a body movement class taught by the head teacher. It was quite an experience. First of all, I must tell you what this class of 9-10 year olds wore during this class--just their underwear! The boys wore underpants and the girls wore underpants and undershirts and all seemed to think nothing of it, except Mary Lee Baumgartner and myself. Another word about their underwear before I continue: it was the brightest display of colors and patterns one could imagine.

After recovering from the shock of all this, I began to notice the same freedom and lack of inhibition in the activities that I've written about in earlier pieces. Children were working on balance and how they could balance on different parts of their body. The head teacher asked them to try different balances of their own choosing to see what worked best. You might think there would be chaos at this time. There wasn't. All the students practiced in their space, investigating different types of balances. They were then asked to choose one favorite balance, practice it, and then another and another until they had up to four. Then they connected the balances with other movements that seemed smooth and natural and finally came up with a routine that was unique to each individual. Next they were asked to pick a partner and perform their routine for that person. The head teacher then asked if anyone wanted to perform their routine for the whole group. It was a delight to see the children so free to move and express themselves.

MATH EXPERIENCES

Nancy Sweet

The children I observed in Sheffield had hands-on experience with math concepts from the very earliest age. The first such experience I noticed was in the infants level equivalent to our kindergarten. These children had three large sand boxes. One was kept dry at all times, but the other two had various degrees of wetness and/or soupiness depending on how much water had been added by the children. This decision on quantity of water was theirs and it usually only took one episode of "overwatering" for a group to decide how much water was the right amount for what they wanted to do.

The next class I watched was working with measurement on a more sophisticated level. These were six-year-olds whose teacher had a table and several large buckets of water set up on the patio just outside her classroom. She had provided them with various measuring devices--cups, jars, liter bottles, etc., and worksheets. The worksheets required the student to make an estimate first: I estimate that _____ cups will fill the liter bottle. Then the student had to fill the bottle to determine the actual count which he recorded on the worksheet. Finally, he evaluated his estimate with a closing sentence: My estimate of ____ cups was a good/bad guess. Another variation had children doing similar activities with length and width.

In every class I saw children using various manipulatives to aid them in their discovery of math concepts. Most frequently used were Diene's apparatus--a set of graduated cubes and blocks to help teach place value, peg-boards or geo-boards for teaching geometrical figures, and Cuisenaire rods. In addition, children were expected to illustrate their math discoveries in many cases, especially when working with geometric concepts. They used graph paper to duplicate figures they had created on the geo-boards and were then expected to write a few sentences about the figures after they drew them on the graph. Thus ey wedded math and measurement with language and writing.

Math classes were individualized in all the classes I visited. I never saw a lesson being taught to an entire group of children. Instead, the children usually worked in pairs or threes. During this time the teacher usually sat at a table and children would come to her for help when needed. Children also brought finished assignments to the teacher who checked it on the spot and either approved it, in which case the student went on to the next lesson, or indicated a problem area for the child to correct or do over. I never saw a paper graded as we know it here--i.e. a letter or number grade placed on the paper.

In general, emphasis was on the learning of math concepts and the application of those concepts to everyday life where possible, not the force-feeding of mechanical procedures.

BRITISH EDUCATORS SHARE THEIR VIEWS ON MATHS

While we were working in Sheffield, an old friend, Alan Shaw, came from Clitheroe, Lancashire, for a visit. Alan is head of the maths department at the secondary level. He brought with him position papers written by teachers which guide the work of his staff. Because the work was given to us second-hand, we don't have authors' names save to say that they are in currency with Shaw and his colleagues. These papers are applicable throughout all grade levels.

Investigative Techniques:
Some Practical Suggestions

The following list suggests a range of ways for you to set about planning or introducing the use of investigative techniques into your mathematics teaching. These techniques could well be applied to other areas of the curriculum.

Encourage your pupils to:

1. guess and approximate.
2. ask questions .... "what happens if ...."?
3. communicate with fellow pupils (and with you) both orally and on paper.
4. play with materials and ideas.
5. check their findings - look for errors.

Do:

6. value pupils' ideas and suggestions.
7. provide wide-ranging experiences for your pupils.
8. listen to pupils' questions (and answers).
9. look for mathematics outside the classroom.
10. plan to give some of your mathematics time to problem solving and investigations.
11. offer help - but not too much.
12. experiment with different group sizes - the whole class, small groups, individuals.
13. discuss the investigation with your pupils, particularly when (if ever) it is finished.

Do not:

14. be afraid to say you don't know.
15. assume that all mathematics has to be taught via investigations - it is simply one valuable tool.

Skills and Strategies for Investigations and Problem-Solving

These are skills and strategies which teachers need to encourage children to develop. However, they need to be expressed in an appropriate form for interpretation by the children.

1. Make sure that you know what the investigation is about and that you appreciate the nature of any constraints.
2. Plan how you are going to set about the investigation.
3. Look at simple cases first.
4. You may need a period of almost random experiment at first but eventually you ought to attempt to be systematic.
5. Do not change too many variables at one time.
6. Recording:
   (a) Write down what you are doing or use a tape recorder.
   (b) Tabulate your results.
   (c) Use graphs, diagrams or symbols when they are helpful.
7. Coming to a conclusion:
   (a) Look for patterns.
   (b) If you find a pattern use this to predict further cases and check whether they fit.
8. Try to generalize your findings.
9. Try to prove your conclusion.
10. If one approach does not work try another.
11. Compare your results with those of other people who have tried the same investigation.

Language And Mathematics

Consider the role of language in the Mathematics classroom.

Look at the formal language of Mathematics we have inherited from our University and College lecturers, and indeed the model of formal Mathematics teaching they gave us. Contrast this language, internalised by those of us who were successful at reproducing the tricks, with the natural everyday language of the average child, and their need to construct concepts within the framework of their own language tools. It could be that heavy emphasis on the jargon of Mathematics is a barrier, just as the over-emphasis on formal proof (our received model) and the need to "cover the syllabus" prevents the majority of children from owning Mathematics.

There is an element of Language development to consider here, especially with our high ESL (English as a second language) incidence. However, though Computer Education sessions brought to light areas of language need, the use of computer stimulated investigations revealed several cases of reputedly slow children making astonishing deductive leaps. It may be that language-free dialogue with the computer enabled some children to think things through, and we teachers to see the connections they made, even though the normal language medium usually represented a significant barrier.

It now seems to me that we Mathematics teachers have a duty not only to ensure that our language, and the language of the media we use (textbook, worksheet, whatever) is appropriate to the linguistic (not just the Mathematics) level of our classes, but we must also take steps to manufacture a learning environment which fosters the maximum discussion in the natural language of the class, or the colloquial English possessed by the class.

In all cases where children are involved in a problem, you will hear them talking using their own terms ("You divide this by that and you get this one here": "What have you got?": "Well that's got five and this has got four.") In extreme cases you will observe individuals accurately predicting outcomes, yet being unable to verbalize their methods - their linguistic tools do not match their capacity to synthesise mathematical relations. In a formal Mathematics exam, they would most likely fail, because the ritual of formal Mathematics is foreign to their linguistic experience.

Investigation In Mathematics

For a while we have been concerned that Lower School SMP (maths) work doesn't encourage pupils to think deeply, but rather that it encourages quick answers and one-line responses.

I wanted to find ways of developing pupils' reasoning powers, encouraging them to plan a series of steps that would lead towards a solution. I wanted, also, to create opportunities for pupils to talk about Mathematics and to pool and utilize their knowledge in unfamiliar situations.

Some of the work has arisen from computer presented problems, and some from the use of traditional geometry-type problems.

The work has been valuable. It has allowed pupils to apply their knowledge and to raise ideas, even misconceptions. Brought out into the open for discussion, the thought processes involved can be seen, as can different ways of tackling problems. The discussion must not be teacher-dominated, though I believe the teacher has a very important and quite different role. There is an opportunity for the teacher to work alongside pupils, to be seen thinking and responding to a problem and to pupils' ideas.

In this work the teacher's role is rather different from that of source of all knowledge, initiator of all action, and judge of answers. In the whole-class lesson I see the teacher as chairperson, keeping order, ensuring that pupils wishing to speak get the chance and sometimes calling on others to contribute, reflecting back ideas for other pupils to clarify, extend, amend or reject (with reasons, of course).

Here it is important:

to allow pupils to explore apparently blind alleys
to tolerate silences
not to impose one's own ideas
not to dive in with partial solutions
not to rush pupils
to give time for thinking
to sense when guidance is necessary

The guidance which may be given is of ways to investigate the problem further:

> "Could a diagram help?"
> "Does this remind you of something you have done/seen/used previously?"
> "What do you know about this situation?"
> "What can you find out?"
> "What can you say about these numbers/this pattern/this graph/diagram/sketch."
> "Do you agree that ...."
> "Why do you think that ...."
> "What is the difference between this situation and that one."
> "Why can you say that now when you couldn't before?"
> "What has changed?"
> "Can you say any more about this problem?"
> "Do you think that someone else could find out more about this problem?"
> "Why can you not find out any more?"

The teacher's role in the classroom is to receive pupil ideas in a neutral but accepting way and to invite the group to consider if they agree with the idea. The teacher's role becomes one of regulating group discussion. This is not an appropriate vehicle for teaching pupils, new facts, knowledge or information. Problem-solving is an exercise in pupils utilizing previously learnt material by organising it in a new way (though there ought to be mechanisms to allow spontaneous exploration of new territory). The purpose of problem-solving/investigational work is to teach pupils, through their participation, strategies for tackling unrehearsed problems.

We and our pupils need to get away from the idea that pupils are responding in order to talk to please/impress the teacher. In this work they are offering their own ideas to the group.

The Learning Environment

There are some pointers to a successful learning environment, and the Cockcroft Report itemised some of them. Paramount is the opportunity for children to talk Mathematics - but it must be on their own terms, not within our perception of formal mathematical vocabulary. I guess that many children, having verbalised a generalisation, may then want to formalise things by asking how the teacher or mathematicians "say it".

Time is crucial. When we learn, we need time to puzzle things out, to connect facts, to put things in our own words. We do not like to be rushed. Why should we then rush our pupils "to get through the syllabus". What does it mean to get through Book C by Christmas - does the child learn by osmosis?

A diet of blackboard demonstrations is sterile for the majority. Apart from the question of personal time to sort ideas out (do you find it easy to copy and think?) the individual is not involved in the discovery of the ideas, and does not have an opportunity to practice the language. There is too much of the INCULCO rather than the EDUCO! Will such knowledge be internalised?

I am not being totally anarchic to the extent of abandoning formal teaching. I would argue that timing should be pupil-oriented. Think of those people who learn something because they have chosen to do so - such learning is much more effective. A model for us would be children asking us for knowledge necessary to unlock the next stage of their self-appointed investigation, or for us to call the group of investigators together because we can see that a lot are approaching a stage where they will need some more tools.

An Investigation

Some pupils were put in front of a computer program which drew a circle with a large number of chords. They were given a piece of blank paper ruled to show three columns with the headings POINTS, LINES, NOTES and told that the SPACE BAR was sometimes useful. Other than that nothing was said, and the pupils left to their own devices. After 30 minutes most had set themselves a problem and were rapidly generating a lot of mathematical information, coincidentally to formulate a rule to predict the number of lines. After 45 minutes over half had generated a non-trivial algebraic expression, with no prompting from the teacher, and were able to use it to successfully predict some awkward cases specified by themselves and the teacher.

The crucial feature of this "lesson" was the fact that the children had independently set themselves a mathematical problem. The teacher formally uttered less than 50 words during the whole session. The only positive intervention was made by giving one pair a postage stamp sized piece of paper to do their crucial working-out!

Investigations

A few years ago, I would have been uncomfortable doing practical work, or investigations, with other than very bright or remedial groups. There was a syllabus to "get through", and groups needed to be continually pushed to cover the necessary groundwork in time. When I did pluck up courage and had pupils out measuring, writing projects, making wall charts, the seemingly slow progress and, above all, the difficulty in finding marks to put into the record book, heightened the sense of comfort when we reverted to "normal" math teaching.

While I am still not totally at ease with a more free-floating approach, there are certain encouraging factors: -

1...Understanding Process Over the last few years ASE (Association for Science Education) has been stressing the importance of teaching understanding of the scientific method, the search for underlying scientific (mathematical) laws, and even more practical work. This is paralleled by the greater emphasis on understanding the principles of landform creation, and the mathematical treatment of the growth of trading networks, rather than the traditional descriptive approach in Geography, and the noises now being made by Sir Keith Josephs, Minister of Education, on the need for less facts and more process in Education generally.

2...Social Needs It is now realized (by employers and industry) that to maintain whatever standing we still retain as a first division industrial nation, we ought to be training our children in information gathering and processing skills, flexibility and adaptability, and above all to be capable of assimilating novel ideas and technologies. Far from the local businessmen's demand for unthinking human calculators (a demand based on needs perceived in the known past), education should train youngsters to be ready to exploit things as yet dimly seen. We know what sort of changes have occurred in the last 50 years, and the way industry and society have had to adapt. We can only extrapolate the rate of change, both in the technological innovations, and in the size of organisations, to see that the only certainty is change itself.

3...Cockcroft Report This report legitimises the value of a more practical, investigatory approach.

Mathematics teaching at all levels should provide opportunities for:
Practical work
Exposition by the teacher
Practice
Discussion
Problem-solving, and applying results
Investigations

Remember that this constitutes a list of the features of observed successful teaching practice in Mathematics.

Some targets in mathematics teaching

This section states a number of targets (at this stage not to assert them as Aims or Objectives) which I hope the Mathematics team can share.

1...We want to maximise external exam results...
...but not at all costs!

2...There are Core topics which must be learnt and must be reinforced with drill and practice and revision.

3...Mathematics and Language cannot be separated. While it is possible to teach Mathematics without the medium of a spoken language (I have successfully taught Vietnamese children without using English), and recognising that people do manipulate mathematical concepts non-linguistically, children must be able to communicate mathematical ideas and have the necessary time to internalise communicated ideas. The vocabulary of Mathematics, is essential. Equally essential is the exploitation of English to building and explore communicated concepts. Adequate time for class discussion, for children to gain confidence in expressing and testing concepts orally in the medium of English, and time for individuals to translate to and from their thinking language, is of paramount importance. Discussion, teacher-class, small group, and one-one, must be regular features of Mathematics lessons.

4...Mathmetics and Computers. Computers were invented to aid Mathematics, though 80 percent of current use is information based rather than Math/Scientific. Recent development of Computer Studies and Appreciation in the majority of British schools tends to underplay the Math/Science element. In my view, the best way to teach about historical uses of computers is in History time, and to bring computers into full mathematical use in Mathematics time. Pupils should therefore learn how to exploit the power of the computer as a mathematical tool.

5...Industrial Mathematicians. Here is a scenario for real world Mathematics:

> A firm has a problem and gives a brief, in layman's terms, to a mathematician. The mathematician's first job is to determine the apparent parameters involved, and from these establish the independent and dependent variables, discover the best-fit relation, and use it to state some solutions. The optimum solution must then be given to the firm in layman's terms.

2606

When we teach new techniques, we must at first present the simplest cases. We must not stay too cosy - pupils must learn to determine for themselves which information and parameters are relevant.

6...Teacher as chairman/learner. Society, when charitable, sees teachers as oracles distributing wisdom and irrefutable knowledge. I think this is based on a misconception of the axiom that the education system should serve to pass on the accumulated wisdom of generations. Wisdom yes - facts no! We no longer believe in phlogiston theory. Our perspectives and subject matter change, so we as teachers change, learn and grow. Our pupils must understand that, and accept that we can occasionally be wrong. In technological, as in other revolutions, teachers and classes will have to learn to learn together - "I'm sorry, I don't know the answer to that one, let's work it out together."

7...Associated with this last target is the nature of classroom dynamics. The traditional relation is teacher-class. The microcomputer has the capacity to introduce other dynamics. Obvious examples are computer-small group, and computer-individual. A powerful new grouping is computer-teacher and class. Here teachers can join their classes and react to stimuli as new learners themselves - the pupils can make genuine contributions, learning is a cooperative effort, and with hard problems the class can learn how the teacher goes about their solution.

8...Practical work. Mathematics is not a paper based subject. Paper is useful as a means to perform calculations and record results and important notes, always as the result of some mental process.

Napoleon took mathematicians on his Nile expedition to help survey the country, perform scientific tests, and generally help with logistics and statistics. The growth of a mathematical priesthood in early civilisation (including Neolithic British) was stimulated by the need for statistics and the astronomy associated with sowing crops, and designing and supervising the building of pyramids, ziggurats and henges. It is wrong to teach, say, trigonometry, without showing how it is used in surveying and navigation; the needs demanded the topic.

Pupils must not be misled by a received perspective of relevance, because many aspects of Mathematics become relevant outside their contemporary framework. Riemann's Maths theories in the 1850's came into their own in Einstein's hands 60 years later.

There must be a balance between paper and practical work.

9...Assessment. The pressure to maximise exam results has tended to divorce Mathematics and the real, practical or scientific world. A sad reflection of the current understanding of Education is manifest in Josephs' statements on the need to understand process, and his objectives for criterion referenced assessment and pupil profiling - how does a teacher set about testing processes of problem-solving, discussion and communication skills, and adaptability without creating a rigid structure of testable criterions? It is dangerously easy to confuse performance and understanding.

Cockcroft warns about the dangers of exam syllabuses geared to the need of universities, yet current Government is pressurising for syllabuses geared to the needs of industry. Few people seem concerned about ensuring that syllabuses are geared to the needs of the recipients.

In view of the serious discrepancies between what should be learnt and what can be tested in Mathematics, I view Assessment and Profiling with distaste.

10..Internal examinations. Examinations provide a service.

-they should add to our knowledge of the pupil
-pupils should learn about themselves. It is important the exams have adequate preparation, and that pupils can identify with the challenge of sitting them. Pupils should have an idea of what sort of marks they are capable of, and that the marks are earned, not assigned in some grand lottery.
-pupils should gain confidence from internal examinations in order to face external examinations.

In general terms I am more interested in weekly progress in independent work and continuous observations of enjoyment, participation in group discussion, confidence in tackling problems, and the eagerness to follow up tangential or parallel topic work.

Should Children Be Asked To Adopt A Mathematical Truth Purely On My Authority?

By simply pouring out fact and formula, many children have a dislike and fear of maths; they come to rely heavily on memory and guesswork. If truths are to be realized by pupils, then situations must be provided in which these truths can be discovered.

Investigations, learning by discovery, by active participation of pupils, call it what you will, must lead to more sound and lasting learning.

When pupils explore for themselves, they make discoveries they want to communicate to the teacher and to other children. This results in discussion (not a bad thing but I admit sometimes difficult to control). It is important that pupils learn to work together quietly, each contributing their own share in the discovery.

Investigative learning makes children more alert and ready to think for themselves - their powers of reasoning become more developed.

Children of all levels of ability should be able to successfully solve the problems set (hopefully by themselves) if these are carefully selected. Perhaps the more intelligent can take the discovery way beyond that which we ask. The less able child may content himself with the more practical side. In any event, the reasoning power needed in problem-solving should help to raise the general standard of performance.

One danger in problem-solving can be that teachers can do too much for their pupils - show them what will happen, draw conclusions for them and show them how to tackle problems in such a way that no problem exists. In short, not allow pupils to find out for themselves.

I have undertaken only a few actual problem-solving lessons as such, purely because I have needed all the time available to complete the syllabus for the exams (!!!). Having said that, I feel that investigations, if combined with what has become known as "class" or "formal" teaching, can lead to pupils not only "doing maths" but "understanding" what they are doing in maths".

Problem Solving In Mathematics

The following jottings are taken from "Thinking Things Through" by Leone Burton. The sentences mean something to me, and may ring some bells for you.

1...They (teachers in a project) were encouraged not to provide answers or methods but to provoke their pupils into searching for these themselves.

2...Spirit of enquiry
First and essential, is the existence in the classroom of an atmosphere of enquiry.

3...A questions board or a questions file in the classroom can be used to collect questions and one period a week could be devoted to exploring some of them.

4...Solvers must have the feeling that the problem "belongs" to them.

5...Provide your pupils with a model for problem-solving behaviour by making sure that sometimes they see you attempting questions. (Let them see you sweating!)

6...A feature of the behaviour of experienced problem solvers is their possession of a repertory of useful strategies, general and specific, which guide and inform their problem-solving behaviour.

7...Removing such pressures (to come to conclusions within a fixed time, or to cover so much work) seems to allow space for the use of imagination and creativity which gives the pupil a strong sensation of "owning" the resulting work.

8...Employers underline the necessity for collaborative problem-solving skills in many areas of employment.

Questions Which May Be Asked By Teachers and Parents

Question 1. What is an investigation? (A full answer will not be apparent until you have tried a number yourself.)

An investigation is usually initiated by an open-ended question which allows the child to approach the problem in his own way in order to make mathematical discoveries.

Question 2. Why use investigations? What value are they to children?

Investigations require children to think mathematically and consequently to develop a number of the skills and techniques of problem-solving. This involvement is likely to produce interested and highly motivated children.

Question 3. Are there different approaches to investigations?

Yes, some investigations are more teacher-directed than others. However, it is felt that the more self-initiated the investigation, the greater will be the 'learning value'.

Question 4. Which approach to investigations should I use?

This will depend on the age-level, question posed, resources available, ability range and perhaps more importantly, on the previous mathematical experience of both the teacher and the children.

Question 5. Are investigative approaches appropriate to all areas of mathematics?

Investigations can be used in all areas of mathematics. It is an effective approach to learning (as has been shown in many infant classrooms) and it is possible to cover a number of elements from the secondary school's examination syllabus by investigative methods. However, investigation is just one approach to acquiring mathematical concepts and skills and it may not always be the most appropriate teaching method.

Question 6. How should the class be organised for the introduction and development of investigations?

The investigation can be carried out as a class, small group, or individual activity. Some investigations, however, are less suited to a class approach owing to the varying levels of ability and experience found in all classes.

Question 7. Where will I find suitable investigations to work from?

There is a growing fund of material in books and magazines.

June 18th 1985 Nigel Lewis.

The Leaves.

1. The Leaves had a wonderful frolic,
The danced to the wind's laud song,
They whirled, and thay, floated and scampered
They cirtled and few along.

2. The moon saw the little leves dance,
Each looked like a small bown. Bird,
The man in the moon smail and lisend,
And this is the song he heard.

3. The north Wind is called is calling,
And we must whirl round and round
And then when our dacing is ended
We'll make a warm quilt for the
ground

by Nigel Lewis
age 9

Our Bonzo

Our Bonzo is a Great Dane. He's about four foot tall. We have to tie him up outside because when he's in the house he wrecks it. When he goes back outside it looks like theres just been an earth quake. Anyway one day we went shopping. We had to keep him out side. When we came back he'd gone. Vanished. We went everywhere looking for him. Even up to Thrybergh. But we couldnt find him. My mum said "Dont get upset. We'll put an advert in the paper."

"O.K." I replied rather sadly.

That night I cried my self to sleep. My mum and dad came up to comfort me.

"I told you not to get upset" my mum said.

"But I miss the way he jumped up at me and knocked me down." I sobbed.

They went out and shut the door. I could hear them talking. They said they would put a reward up. Fifty pounds. About a week went by and then somebody came with a Great Dane. I took one look at it and said "Thats not it."

"Why?" my mum asked.

"Because Bonzo is a dog and thats a bitch." I replied

"So it is" my mum said "I distinctly remember saying that it was a dog in the advet."

The man went away and took his dog with him.

Then I thought, what about that Great Dane bitch we knew down in Corn-wall.

I asked my mum if she would let me go down on the train. On my own.

"NO." she snapped

I ran upstairs and slammed my bedroom door.

I'll run away to Cornwall I thought. So I did

I looked in my money box. I had ten pounds. I was just about to go when I heard a whining sound. I opened the door and there was Bonzo. Shivering. I shouted my mum and dad. They took him to the vets. He died of pneumonia.

We never got another dog.

Karen Spillane 10

Schools Visited

Concord Middle School
Head: Mike Delaney
Fife Street
Sheffield 9

Dalton Foljambe Junior and Infant School
Head: Philip Wood
Foljambe Road
Dalton
Rotherham

Gosforth School
Head of Maths: Trevor Case
Stubley Land
Dronfield Woodhouse
Sheffield

King Edward VIIth School
Head of Maths: Ed Wilson
Glossop Road
Sheffield

Lynncroft Junior and Infant School
Head: John Dichmont
Eastwood
Lanley Mill
Nottingham

Northcliff Comprehensive School
Head: David Lingard
Head of Maths: Paul Wood
Gardens Lane
Conisbrough
Doncaster

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Head: Bob Driscoll
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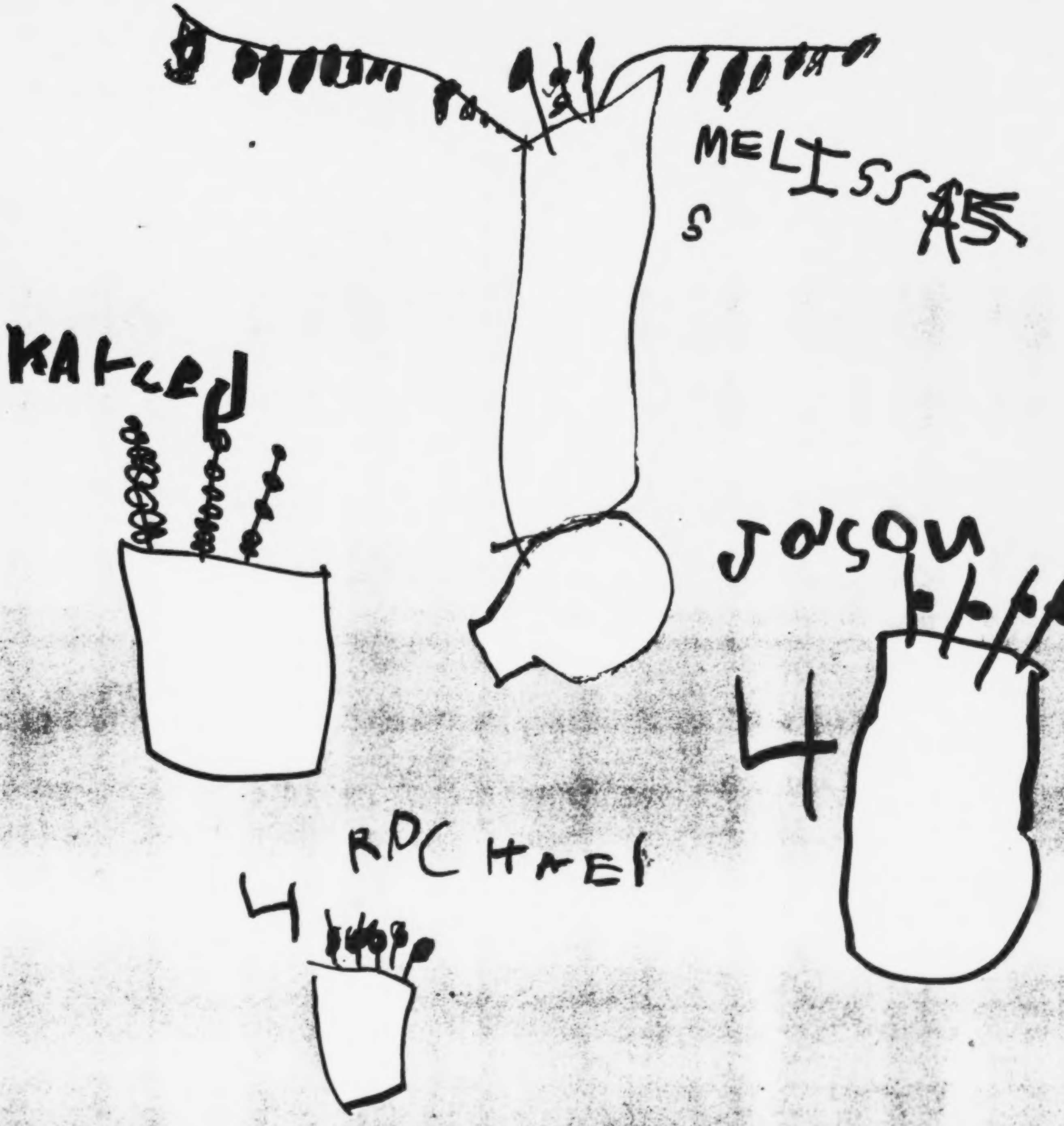
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SEEDBED

SEEDBED

NUMBER 25

JULY 1986

Teachers' Center Project

SIUE

Southern Illinois University
at Edwardsville

2618

INTRODUCTION

It's been a long time since the last SEEDBED! But now we are happy to produce not one but TWO new issues.

The present SEEDBEDs owe their being to many people.

Barbara Goldenhersh edited SEEDBED 25 and 26 (and begins now 27 and 28) with verve and thoughtfulness and care and a lot of late nights learning to cope with new technology. Thank you, Barb!

And thanks to our teacher-authors who have some very thoughtful and down-to-earth (but not so commonplace) ideas and researches and comments on children's educational growth and well-being. Special thanks to guest author Constance Kamii for her kindness to SEEDBED.

Major support was given to the present SEEDBEDs by Mary Steffen, visiting teaching fellow at SIUE, whose students contributed mightily here, and to Patricia Atkinson and Sheryl Favre, without whose good humor and hard work you'd see scrambled eggs.

And thanks to SIUE's Dr. George Kurtzrock, who allowed us use of a Mac computer and to Marge Kosel and Tom Prosen (Sunburst Communications) on whose equipment the present SEEDBEDs were printed.

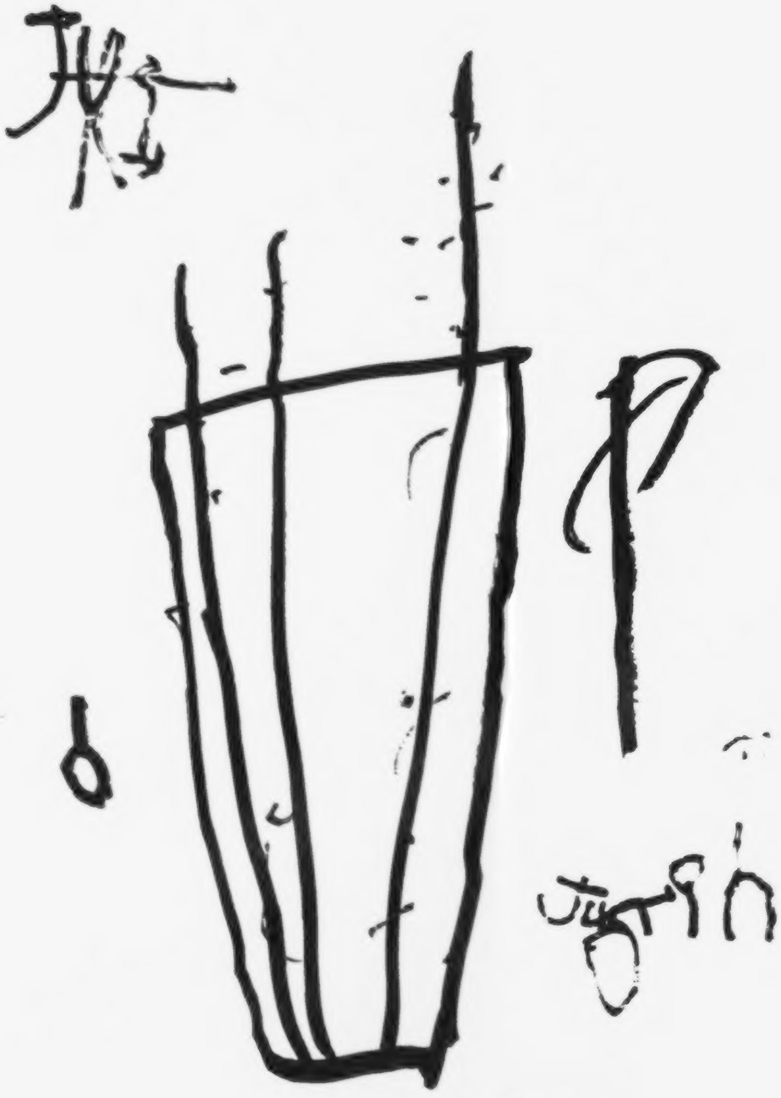
The ideas are the same as those of the twenty-four issues we've published: 1) KIDS COUNT and 2) Knowledge is not a spectator sport.

The look of SEEDBED has changed a bit. With lots of scrambling and late nights and borrowed technology and enormous goodwill all around, we are happy to make available SEEDBEDs 25 and 26.

Thomas C. O'Brien, Professor
Teachers' Center Project

ABOUT THE ARTWORK

The art in SEEDBED 25 comes from children in Barbara Goldenhersh's class at Presbyterian Community Preschool in Belleville, IL. Children were shown a vase containing five pussywillows and asked to show how many pussywillows there were so that someone who was absent that day would know how many were there. The task was suggested by the research of Ann Sinclair, University of Geneva. What can YOU find out about children's attention to number, given the drawings children have done? One aspect of the artwork, Barb Goldenhersh points out, is that "number" for these children meant "age" and so they drew their age (in numbers and in other ways) rather than attend to the task originally posed.



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A LOOK AT CHILDREN DRAWING

Joyce Bishop

Jacqueline Goodnow's book CHILDREN DRAWING has been a revelation for me. In it, she gave order and logic to the diverse results one sees when children draw. She interpreted children's drawings as a series of solutions to problems. This "visible thinking" displays thrift, conservatism and principles of organization and sequence which are features of all problem solving, whether by children or adults. (p. 145) The choices children make in this problem-solving depend on their degree of development. Furthermore, she proposed that we ought to be able to set up conditions which will yield certain kinds of drawings.

I made arrangements to visit a pre-school where I could try some of the experiments she suggested and see if my results would come close to those she predicted. I prepared two sheets of paper for each child with two activities on a sheet. Goodnow divided her investigations into three main lines: analysis of patterns, attention to sequence, and study of questions of equivalence, or the nature of "same" and "different". The activities I chose dealt mainly with the first two of these.

Goodnow said that as they draw, children usually adhere to two general principles: to each its own boundary, and to each its own space. (p. 34) Generally, children avoid overlapping. If you give them a drawing problem for which overlapping is one solution, how often will they use overlapping, and what other solutions will they find? The teacher of the class I visited had offered to let me study pictures of themselves which the children had drawn for Open House, "free" drawings without external conditions. I proposed to compare them to drawings done according to one of Goodnow's suggestions which blocked one of the typical methods of dealing with parts competing for the same space: omission. I would give them a figure consisting of a circle from which two vertical lines extend downward, and ask each child to draw hair and arms. (pp. 40-41) (Drawing I) A common interpretation of this figure would be that the circle represents the head and torso, and the two lines are legs. How would the child solve the problem of drawing hair and arms which should fit into the same space? Would their "constrained" drawings be much different than the "free" ones?

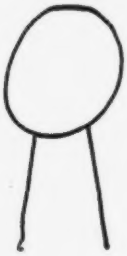
Another way of looking at how children deal with problems of overlapping space is the train problem. (p. 46) Starting with a train shape composed of a rectangle with two circles drawn on the lower side so that they take up nearly all the room on that side, I would say "This is a train. The child who drew it wanted to put in two more wheels but didn't know how. Could you finish the drawing?" (Drawing 2) Would the child give up the convention that the ground is the bottom of the page, or would he overlap to squeeze four wheels into the available space? Would he draw wheels which are a different size or shape? What other possibilities are there? Goodnow predicted that children will go to great lengths to avoid overlapping.

Goodnow's work suggests some questions about sequence in children's drawing. What are the typical patterns and do they appear more commonly in different age groups? What effect does sequence have on the final product? Typical patterns she described in free drawings are left-right sequences, paired and radial sequences, top-to-bottom orders, and from core to accessories. She devised an experiment to look at two aspects of how sequence affects children's drawing: start with a circle and place two dots in some position other than they would be for a face in normal position. Say "Somebody else started this drawing and didn't finish it. Could you finish it?" How would the children deal with the available space and how would they make their drawings agree with the given units? If a child tried to turn the page, I intended to ask him to try the drawing without turning. I would listen for any comment the child made about the drawing, especially the position or activity if he drew a person. (pp. 64-67) (Drawing 3)

One more investigation deals with sequence. Goodnow referred to Gessell's research indicating that in drawing simple figures, "Three rules apply to progressions beyond a starting point: draw all horizontal lines from left to right; draw all verticals from top to bottom; and 'thread' (follow a continuous line without a change in meeting point, as if you were laying out a thread)" (p. 78) What would happen if I asked children to draw figures that require choosing between these rules? I asked them to copy four designs. (Drawing 4)

Starting points:

1)



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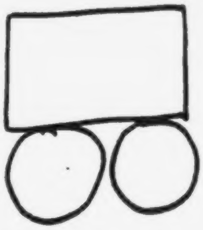

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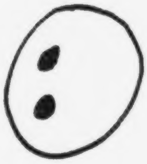

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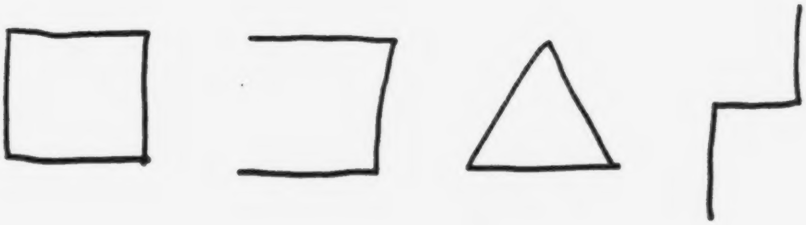


The Children

Nineteen children were present in the pre-school classes that I visited. It was a group of children who were four when the class began in the fall but sixteen of the nineteen had birthdays before June 30, and at least seven had pre-school experience prior to this year. I visited in early May.

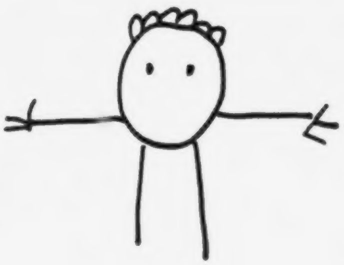
They were cooperative and generally glad to participate. Many seemed attracted to the colored markers I had laid out for them to use. Their responses were interesting and varied.

Arms and Hair on a Figure

In this activity, sixteen of the nineteen children followed the tendency to avoid overlapping. The most common choice (in eleven cases) was to arrange the hair on top of the head circle and draw the arms extending from the lower part of the circle (5a). Three children drew the arms extending from the leg lines (5b). One child drew the arms first, angling down from the top quarter of the circle. Then he drew an additional circle on top of the first one and gave it hair and features (5c). Another child drew hair nearly all the way around the head, then arms inside the circle, and last, features (5d). One child drew hair on top of the head, nice big ears, then arms extending upward from above the ears (5e).

Eleven drew eyes and other features, even though I didn't request them. Often the eyes came first, even before the requested features. Twelve made stick arms and sometimes fingers, while the remaining seven drew some kind of solid shape to represent arms, hands or feet (5f).

5a



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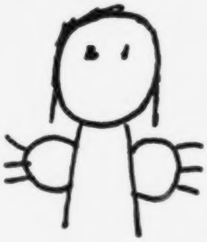
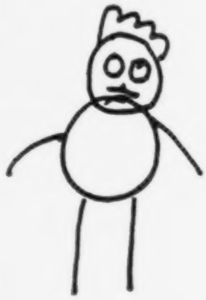


5c



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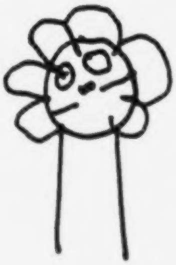
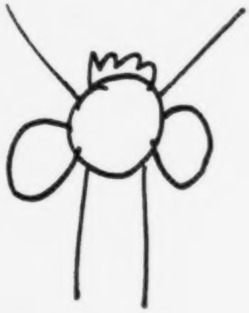
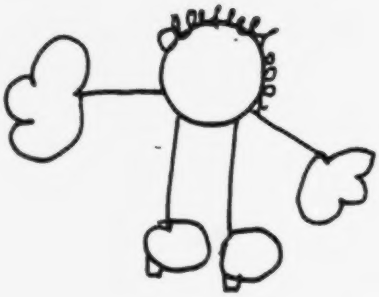


5e



5f



Free vs. Constrained Drawings

I was able to compare free and constrained drawings for sixteen of the children. Ten free drawings lacked either hair or arms or both, so that I couldn't see how they previously solved the problem of where to put both of them in the same drawing. Two of the children whose hair and arms overlapped came from this category; I had no free drawing for the third. I suspect they were inexperienced in solving this drawing problem. However, the other eight of ten who drew no hair and arms in their free drawings drew them for me with no overlap.

Two of the children used an arm-hair pattern different from their free drawings. The constraints of the given drawing might have caused this. Two other children adapted the given drawing by adding another circle on top or by extending the leg lines to make the constrained drawing more like their free ones. A third youngster stopped before she drew all the parts included in her free drawing. I suspect she quit when the limitations of the constrained drawing made it impossible to complete her preferred pattern.

Train

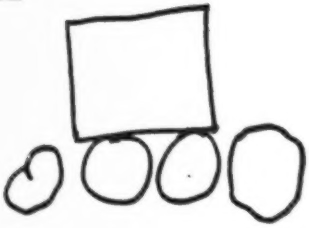
The children were resourceful in dealing with this problem. I divided their nineteen responses into nine categories, some of which could be further divided. Some groups contained just one response, but, without a clear indication of the children's reasoning, I was reluctant to combine categories.

With all the variations, no child made an obvious attempt to indicate pairs of wheels by overlapping the wheel shapes with each other, although three attached their wheels to the carriage so that it appeared part of the circle was under the rectangle.

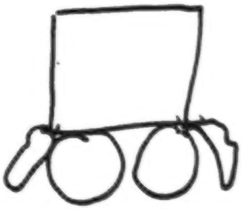
The next most common tendency was to keep the bottom of the page as the ground. Seventeen of the nineteen did this, with several variations. Four children placed one wheel similar to the original on either side of the originals, without touching the originals (6a). Six others drew one wheel on each end but sacrificed continuity of shape and/or size to squeeze the wheels closer to the corners of the carriage, usually touching (6b).

Three children drew an additional carriage for the two new wheels (6c) and two started over with a new carriage to make room for all four wheels. One of these still altered the shape of the outside two wheels and so is listed in two categories. Another youngster was apparently dissatisfied with his first attempt to squeeze in the two additional wheels, and drew a new carriage with four similar wheels.

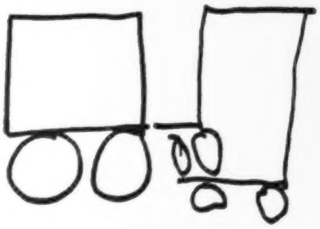
6a



6b

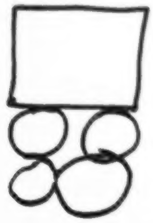


6c



Two more children drew two wheels below the original, one having them touch the originals, and one not (6d). Each of the remaining three drew wheel patterns unique in this sample (6e-g). The last pattern might be an example of serial perspective.

6d



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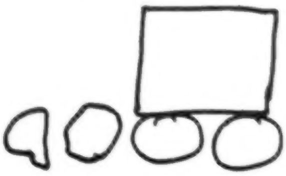

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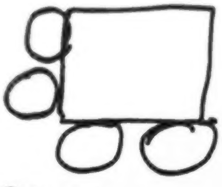
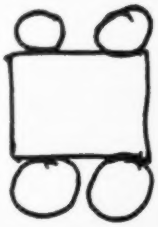


6g



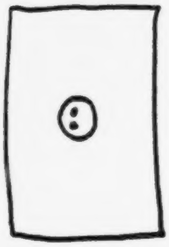
Circle with Two Dots

I placed the paper for this activity in front of the children so that the two dots, arranged vertically were on the left side of the circle (7a). It was startling how quickly the children turned the page to orient it so that the two dots were horizontal in the top half of the circle, apparently interpreting the circle as a head. The fact that we had already completed Drawing I in which the circle represented a head may have influenced them. Only one child drew a non-human figure (7b). She said the two dots on the lower curve of the circle were earrings, and this may be an 'earring tree'.

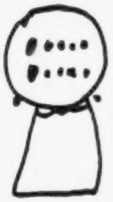
I intended to make sure that they kept the paper in the same position as I had presented it, but it was obviously not comfortable for some. Some had their drawing started with the paper turned before I caught them, and others continued to try to turn the page as they drew.

Most children drew figures oriented to the eye position (7c).

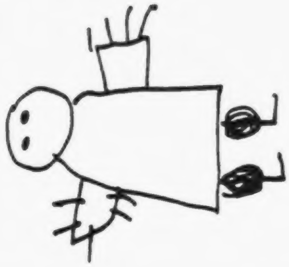
7a



7b

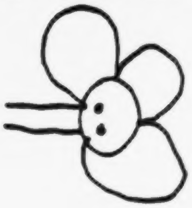


7c

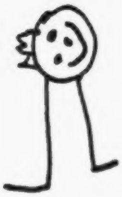


The problem yielded some pictures which are apparently not consistent with the eye position. I say "apparently" because the children did not give a justification for the irregularities so I don't know exactly what they were thinking (7d-f).

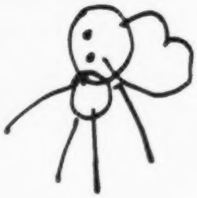
7d



7e

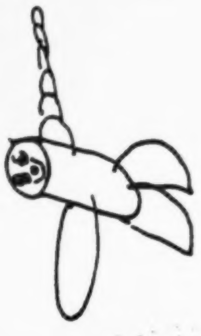


7f

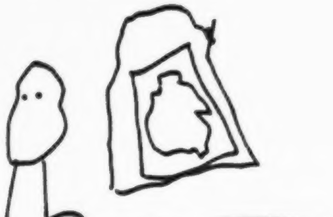


One child reproportioned the human figure to better suit the shape of the paper (7g). Another boy invented a situation to explain the unusual position of his figure and drew more figures to complete the scene (7h). He said "They're jumping out of the boat." The horizontal figure, then, is in the water.

7g



7h



Fifteen of the nineteen drew human figures consistent with the eye position, even though they would normally position the figure vertically on a page that is taller than wide. It seems that the sequence of drawing, the positioning of the eyes to orient the head, has greater effect than available space, or position on the paper. Five children did draw arms as long or longer than the legs, possibly to fit the drawing to the proportions of the paper.

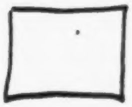
Copying Shapes

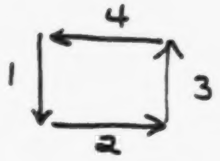
As the children copied the four figures, I noted the sequence and direction of their lines. Later, I analyzed their responses to see which of the three tendencies they observed:

a) draw all horizontal lines from left to right
b) draw all verticals from top to bottom
c) thread (draw figure in a continuous line)

When it became necessary to choose among the three, which principle overrode the others?

Example:





The child begins with the top to bottom, then left to right, but threading dominates because he continues on around the figure instead of drawing the remaining lines top to bottom and left to right.

The following charts attempt to show the results of my analysis:

description	no. of children
threading dominates in all 4 figures	5
threading dominates in 3 figures	7
threading dominates in 2 figures	5
top to bottom dominates in all 4 figures	2
	total 19

started figures at the top all 4 times	8
started figures at the top 3 times	5
started figures at the top 2 times	3
started figures at the top 1 time	1
started figures at the lower left corner all 4 times	2
	total 19

When the threading dominated in two or three figures, I observed the following underlying preferences:

preferred top to bottom	7
preferred left to right	3
no obvious preference	2
	total 12

To condense this, the children started their figures at the top 54 of 76 times, but in 52 of the 76 figures, threading later dominated when a choice became necessary.

The tendency to work from left to right came in a distant third, dominating in only three cases. Results like these make the task of teaching reading and writing based on left to right motion seem formidable. And, are there implications here for teaching cursive writing at an earlier age? The topic is worthy of research.

Conclusion

Comparing my results in the Hair and Arms on a Human Figure problem to Jacqueline Goodnow's, I find the same dominant tendency to avoid overlapping. I had proportionally fewer children who drew the arms extending from the leg lines, and slightly more who did show some overlapping.

In the Train problem, Goodnow described all the variations which appeared in my sample, except the two wheels added below the originals (6d). In nearly l00 children age three to seven, she saw only one case where a child drew wheels overlapping; in my nineteen, I did not see any.

In the Circle and Two Dots problem, Goodnow noticed that children occasionally converted the figure to an animal, which I did not observe at all. One youngster did produce an inanimate object. As stated earlier, this activity followed the Hair and Arms on a Human Figure problem, which may have encouraged the children in my sample to see the given figure as human. I worked with just one youngster who explained a sideways figure. Perhaps if I had been more efficient at keeping the papers in the original position, I would have elicited more of these explanations.

When it comes to Copying Shapes, Goodnow says that the preference for threading increases in the pre-school and kindergarten years, and then declines. It is the dominant tendency among the children with whom I worked. She presents a chart of Gessell's results on studies of shape copying which indicates that drawing left to right should occur more often than drawing top to bottom, but I found the reverse. However, the even stronger tendency to start at the topmost point, not considering which way the line goes from there, may be a factor.

This project has convinced me that children's drawings are not entirely random, but follow certain principles. I've seen for myself that it is possible to set up certain conditions that will yield predictable results.

A great deal of information about children's thinking is available from their drawings, their earliest written work. I have appreciated Jacqueline Goodnow's orderly framework for examining this work and also her obvious love for children and delight in their ingenuity.

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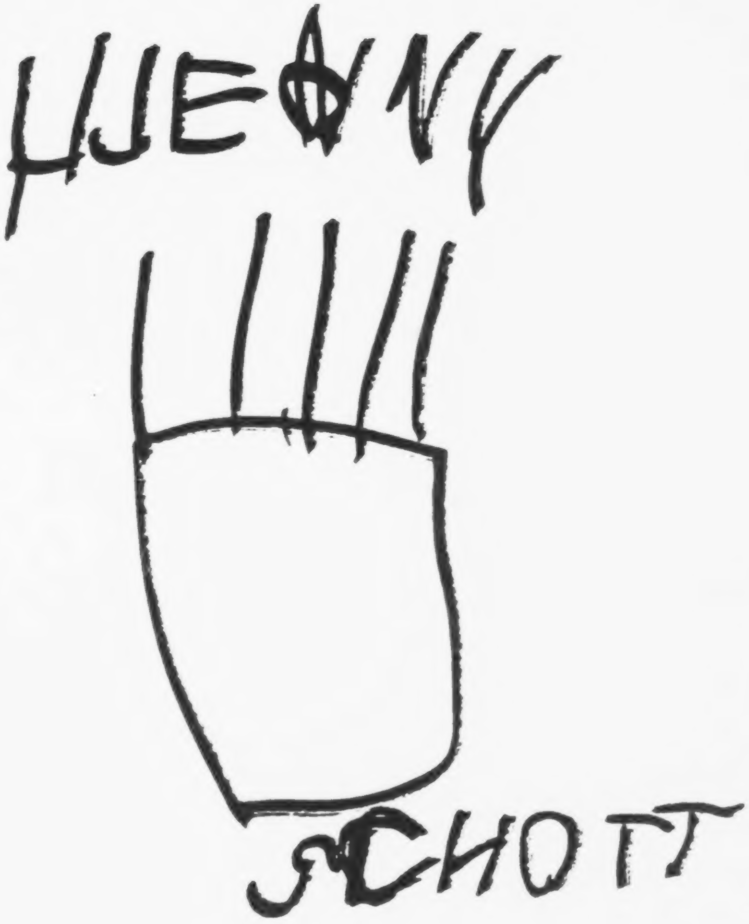
2. A. Gessell and L. B. Ames, "The Development of Directionality in Drawing,": JOURNAL OF GENETIC PSYCHOLOGY, I946, 68, 45-61.



KINDERGARTEN - A TIME FOR EXPLORATION

Stephanie Richie

When I think back to when I was in kindergarten, I remember playing with blocks and using bead strings to make patterns. We were always on the floor doing activities and trying out new things on our own. I remember my kindergarten teacher vividly -- her smile when we walked in, her kind voice, and her great big hugs for encouragement. But, one thing she never did was she never told us what we were supposed to discover through our exploring with objects. We drew our own conclusions without her help. We weren't told what we were to learn before we had done the activity. I feel this is what teachers should be doing. I visited a kindergarten class and how I wish these children could have had my teacher.

When I walked into this class, the first thing I noted was the six rows of desks in perfectly straight lines. The children walk in and go to their desks. If they got up from their seat, they were scolded and told to sit down. This is very hard for 24 five-year olds! The rest of the morning consisted of doing workbook pages, story time, and some kind of art work in which the finished products basically looked alike. I kept thinking to myself, "When do these children get to play and do something fun?" This time never came. Before long it was time for lunch. (This class is in a day care center, so most of the children stay all day.) They ate at their desks and still could not talk much. After lunch, they had to take a nap. The teacher was complaining because they can never sleep. It didn't surprise me since they didn't get to use much of their energy all morning.

Kindergarten is, for most children, the first time they are in any school situation. This should be a year of exploring, finding out new things, a time of self-discovery. These children are so eager to learn because now they are in "school" and feel very grown-up. As I think about this class, I feel very sorry for them because they have been restrained from learning as much as they could. I will always be grateful to my kindergarten teacher for everything she did and most of all, for what she did not do.

MAKING PATTERNS

Brenda Dunning

Throughout a quarter of child observations in different math activities, I have noticed that students make patterns to deal with different problems. It's a fault of much of the elementary teaching of math and other subjects that teachers do not point out and teach these patterns.

Sometimes it's because the teachers do not see the patterns. In my own elementary instruction I was not shown patterns in math and did not see the relationships between different problems. Each one was a separate, all-alone, struggle that I had to get through. It is only as an adult that I began to see patterns.

Each person has schemas for the things that we learn and relate to every day. As we learn new things we either fit these into an existing schema, (assimilation) or we change the schema to match the new idea (accommodation).

But much of the learning that takes place in our schools is taking place as if students do not have schema. I found that the students, when not given instruction on solving a problem, often found a pattern that related to something they already knew. They were often able to handle an unfamiliar problem in this way. I was amazed at the number of ways students could find to deal with a problem. I was equally amazed to see patterns that I myself had not thought of utilizing.

All of this leads me to the conclusion that if students are left to solve the problem themselves, they often will. And if they cannot solve it, teachers should be able to relate the problem to a schema that the student already has. In this way students can see learning as a whole, related process. They can learn that if they know how to solve one problem they have a beginning for solving others.

CHILDREN'S QUESTIONS AND ANSWERS

Renee Barker

There has been so much talk lately about children not knowing how to ask questions. So often when a child does ask a question, it is either ignored or given a flippant answer.

Following is a dialogue in which I helped a student answer a question. My efforts were well rewarded.

Ryan: How long have we had dictionaries?
Teacher: I don't know. A long time ... How could you find out?
Ryan: I don't know.
Teacher: I'd look it up in the encyclopedia.
Ryan: (After checking one encyclopedia) It's not here. Maybe it's in the dictionary ... under dictionary. (He looks in a dictionary.) It's not here ... now what do I do?
Teacher: I'd try another encyclopedia.
Ryan: Can I go to the library?
Teacher: Sure, I'll go with you.
Ryan: (He finds dictionary in the encyclopedia.) Wow! 1500 years ago.
Teacher: Are you sure? (I read the article.) It says 15th century--that's 1400's. It says the middle of the 15th century. What year do you think?
Ryan: 1450 ... How long ago was that?
Teacher: I don't know ... can we figure it out?
Ryan: Uh-hu - (goes to board and writes 1985)
-1450
535
Wow! 535 years! That's a long time.

The help this student received for his question told him it is worthwhile to question and to ask questions.

Surely teachers "waste" at least ten minutes a day. These ten minutes can be used for answering one question each day.

Not only could students learn that questions are worthwhile, but maybe they could learn how to find their own answer. Then there would be no need to teach high school students how to begin research!

This week I asked a nine-year old girl where the sun goes at night. She viewed me as a teacher asking this question. Our discussion follows:
Teacher: Where does the sun go at night?
Jennifer: Um... it depends on what kind of answer you want.
Teacher: Where do you think the sun goes at night.
Jennifer: (hesitation) ... West
Teacher: Is that why we can't see it?
Jennifer: (puzzled) ...it could be behind the hills or the clouds.
Teacher: Good... you've never really thought about it have you?
Jennifer: There could be lots of answers... It could go someplace else.
Teacher: Someplace else?
Jennifer: Yeah, it could go on the other side of the world.

I think this discussion shows several things. First, the student was apprehensive and wanted to know what kind of response the teacher wanted before she attempted to answer the question. When the teacher did not clarify what type of answer she wanted, the student recalled she had been told the sun sets in the west so she gave that as her answer. When asked to apply her idea of the sun setting in the west, it became evident she still didn't understand. Only then did she really begin to think on her own. She then became more interested in finding her own solution than in pleasing the teacher.

After saying the sun could be behind hills or clouds, Jennifer was not comfortable with her answer and kept thinking. This is clear from the fact that she ignored the next questions and continued on with her own thinking.

"Learning in the narrow sense involves the acquisition of new information or new responses restricted to a specific situation... learning in the wider sense, or development, involves the acquisition of general thought structures which apply to many situations." (p. 218)

Do we as teachers usually expect the answer (or process) that will most benefit the child's intellectual growth or do we tend to search out the one word found in the teacher's manual. Students are only able to grow in the area of out guessing the teacher if the latter response is what the teacher is seeking. (And what do we commonly do with "wrong" answers?)

Piaget's work echos over and over that the goal of education should not be to have students simply memorize the responses that are expected of them. Instead, teachers must strive to help students develop intellectually in their abilities to question, analyze, think creatively, and discover the world around them. Only in this way can we help a student create his own network of knowledge he can understand and recreate when necessary.

"The principal goal of education is to create men who are capable of doing new things, not simply of repeating what other generations have done -- men who are creative, inventive, and discoverers. The second goal of education is to form minds which can be critical, can verify, and not accept everything they are offered. The great danger today is of slogans, collective opinions, ready-made trends of thought. We have to be able to resist individually, to criticize, to distinguish between what is proven and what is not. So we need pupils who are active, who learn early to find out by themselves, partly by their own spontaneous activity and partly through material we set up for them; who learn early to tell what is verifiable and what is simply the first idea to come to them." (p. 238)

"Interest and learning are best facilitated if the experience presented to the child bears some relevance to what he already knows, but is at the same time sufficiently novel to present incongruities and conflicts." (p. 226)

We have to begin this process by giving students more freedom to express themselves. Perhaps we should give more credit for an answer that requires some creative thinking than for the repetition of our own words. We must encourage students to think and not simply to memorize and repeat truths which may or may not have meaning.

I don't think this is an easy thing to do. We have all been so conditioned that learning and teaching are merely pouring facts into the minds of students. I do think this is a very important issue and one all teachers need to think very seriously about.

"... facts are but a small portion of real knowledge. True understanding involves action, on both the motoric and conceptual levels." (p. 225)

"The concept that children -- or individuals of any age -- learn best from self-initiated activity is perhaps the most important single propositions that the educator can derive from Piaget's work." (p. 224)

Following two books make excellent food for thought. The quotes used come from the first. Ginsburg, H. and Opper, S. Piaget's THEORY OF INTELLECTUAL DEVELOPMENT: AN INTRODUCTION. Englewood Cliffs, N.J.: Prentice Hall, l969 and Piaget, J. SCIENCE OF EDUCATION ON THE EDUCATION OF THE CHILD New York: The Viking Press, l97l.

ATTRACTING TOP-NOTCH TEACHERS

Fred M. Hechinger

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Congress last week appropriated $10 million to finance a new scheme to encourage talented high school students to become teachers. In Washington fiscal terms, a mere $10 million is hardly considered real money, and so the new legislation, known as the Talented Teacher Act, is in danger of being overlooked. But to judge that measure by its price tag would be to pass up one of the most promising opportunities to give muscle to the recent surfeit of plans for school reform.

At the heart of the act is the realization that unless the teaching profession is able to attract at least a modest number of outstanding young people, there is no hope for greater intellectual stamina in the schools. Current statistics show that teachers are being recruited largely from the lower levels of academic performance and accomplishments. Minimum competency testing will change this; the need is for schools to get their share of the top of the manpower pool.

The Talented Teacher Act will show how to do this by allowing states to offer four-year college scholarships of $5,000 annually to students in the top 10 percent of their high school class, provided that they will move from college to teaching. Recipients would pledge to teach in a public elementary or secondary school or in an eligible nonprofit private school for two years in return for every year they received the scholarship, or for one year of service in schools with large numbers of disadvantaged children. Students who renege on that obligation will have to repay the corresponding part of the scholarship.

Representative Ron Wyden, an Oregon Democrat who initiated the new approach among his colleagues in Congress, said last week that when he asks high school seniors what they want to be, they say: "Doctor, lawyer, maybe business." That, the Congressman went on, "is where the money is."

"That's where the prestige is," he said. "We want the teaching profession to be more competitive -- in prestige and stature -- with law, medicine and other professions." He said he hoped the new act would formally acknowledge "that we need bright young people in front of our classrooms, as well as in the operating room, the courtroom and the boardroom."

The bipartisan legislation was co-sponsored by Senator Paul Simon, Democrat of Illinois, and Representatives E. Thomas Coleman, Republican of Missouri, and Bill Goodling, Republican of Pennsylvania. This year, Senator Arlen Specter, Republican of Pennsylvania, took the lead in moving the act from authorization to appropriation.

The Carl D. Perkins Scholarships, so named for the late Congressman who was known in Congress as Mister Education, will be awarded by state panels operating under publicized selection standards. Such criteria may include, in addition to grades, recommendations from teachers and others, a record of extracurricular activities and an essay indicating why the applicant wants to be a teacher.

Representative Wyden appealed to the Department of Education to publish the regulations as quickly as possible so that the first grants could be made in the coming academic year. "I just took a call from a high school guidance counselor in Perrysburg, Ohio," Mr. Wyden said. "She wanted to know how her students could apply for these scholarships. I want to be able to tell her by the end of January that the applications are ready."

. . .

Albert Shanker, president of the American Federation of Teachers, who in an address in l983 planted the seeds of a teacher recruiting program similar to the military's Reserve Officers Training Corps, said last week. "This nation is in need of more than a million new teachers over the next eight years." He warned, "The teacher shortage is like a ticking bomb and if this bomb explodes, our children and our future will be the victims."

Many other observers are also sounding the alarm that, with an aging teacher force, large numbers of retirements can be expected in the near future. Therefore, little time is left to upgrade the quality of teaching candidates. Once the shortage becomes acute, schools will hire any warm body willing to staff the classrooms. This is exactly what happened in the shortage of the l950's, and once substandard teachers become part of the system, most are likely to stay on for many years.

In rough numbers, the Talented Teacher Act involves only about 2,000 students at year at its present level of financing. Critics will rightly say that this is not enough to satisfy the hunger of a talent-starved system. In fact, Congress originally authorized more than twice that amount of money, but the plan was later scaled down. But the authors and supporters of the act reply that they consider it no more than a beginning. They view it as a taunt to other sources of future financing.

If the Federal Government's seed money -- and the initial appropriation is hardly more than that -- works to attract a few of the best and the brightest, there is no reason why the states and local communities should not join to expand the offering, nor why private funders, such as foundations and corporations, cannot add to what then could become a sizable scholarship fund.

This would also address the present dilemma of saddling undergraduates with sizable loan obligations which discourages them from entering relatively low-paying fields, such as teaching.

It is unrealistic to expect so large a force as the nation's more than 2 million teachers to be recruited entirely, or even predominantly, from the top ranks in talent. Every profession competes for people from the narrow peak of the pyramid. Even if teachers' salaries continue to improve, as they have in the past two years, they are not likely, in the free market economy, to become fully competitive with the most lucrative professional or corporate fields.

What the teaching profession, and the children who depend on it, are entitled to expect is a fairer chance to skim off a portion of the cream. The Perkins scholarships alone cannot do the trick, but they show the way. They might encourage would-be-reformers to move from the wish lists to action.

CONSTRUCTION OF AN ODD - EVEN BOARD

Kara Lavoie

I was given the chance to observe the construction of an odd-even board in a third grade classroom. Each child was to create his or her own board from 1-100, using a red crayon for odd numbers and a blue crayon for even numbers. However, they were not told this, they were only told to alternate crayons beginning with red. Their chart was set up in the following way: 1 = Red 2 = Blue

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

After the first row was completed, the children were asked if they knew what they were doing. Several of them figured out that every other number was red and the other blue. Someone else mentioned that all odd numbers were red and all even numbers blue. They were then asked to complete the chart on their own. While the students were continuing, I was able to observe many interesting things. I was amazed at how many different methods were used in order to complete the assignment.

The bulk of the children picked up the red crayon and filled in all of one row: 1 3 5 7 9 then, they completed the row using their blue crayon: 2 4 6 8 10 This group did one row at a time, all the way to 100. Out of 18 children, 11 used this method.

Five of the children, four successfully, found a more efficient way of filling in the numbers. These students used the vertical rows to complete ten reds, then ten blues in the following manner:

Step 1	1	Step 2	2
	11		12
	21		22
	31		32
	41		42
	51		52
	61		62

This group was further divided into two subgroups. One of these groups wrote the whole number, 11, 21, 31, 41, ..., while the others wrote ten 1's and then added the 2, 3, 4, 5...9, along side of the 1. Both of these groups did one row at a time, switched colors and did the next.

I was really surprised to see two of the "brightest" students changing crayons after every number, all the way to 100.

When the charts were completed the class was asked to look at their chart and report any patterns. They quickly stated the following:

1. All odd numbers are red and all even numbers are blue.

2. Going down, the ones column all ends in the same number.

After further thought they also came up with these complex observations:

1. Using any four numbers that together make a square, the numbers at a slant from each other will be equal.

2. Using the whole chart as a box, the two slants are equal. (A calculator was used to prove this.)

3. Starting at 11 and moving at a slant, the numbers are all doubles. (11, 22, 33, 44,....99.)

The students came up with some very complex patterns in this chart. They were open to all suggestions from other students and they were able to prove the validity or invalidity of each pattern.

CHILDREN ARE PEOPLE, TOO!

Michelle West

Just as a teacher is more than an educator; a child is more than a student. Children are people, too!

Often, we forget children have needs, just like adults - and one need we rarely address is choice. This doesn't appear to be a concern for many educators, but we all need to have choices available to us. Adults do not like to be backed into corners - neither do children.

By making choices available to children, we provide the opportunity to let them think for themselves and give them the chance to make responsible, logical decisions. Even though they will not always make good decisions, they will, hopefully, learn from their mistakes.

Children, for the most part, act in a more responsible manner if you treat them responsibly. This also gives them a feeling of control over their lives; that their futures are not entirely pre-determined by adults.

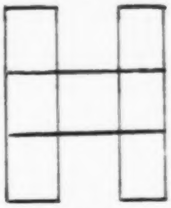
Giving children choices and the chance to govern themselves does not mean giving up control. It shows trust and confidence in the students and in your own ability as an instructor to provide an autonomous learning situation that will benefit the children for years to come.

IZZIE REVISITED

JoAnn Nolte

This problem came from Dr. A. I. Weinzweig, University of Illinois, Chicago Circle, when he visited SIUE some time ago.

Given the rules for Izzie's problem, I was challenged to find all the possible solutions. These are the given rules: Using the numbers I to 7 once each, fill in the boxes below so that the sums of the two columns and the middle row will all be equal.



I began the problem using the trial and error method. After an hour and only one solution I decided to try to find a formula or some sort of logic for solving the problem. The solution I had already had a 2 in the middle and the columns and middle row each had a sum of I3.

(I)

7		4
5	2	6
1		5

I looked at the numbers and their positions to try and find relationships. I noticed that the numbers I to 7 added up to 28. If I subtract the middle number I get the sum of all the rest of the numbers. 28 - 2 = 26.

Since there are 2 columns I divided the 26 by 2 to give me the sum of each column. 26 - 2 = 13. This is also the sum of the middle row.

My conclusion was that I should try all the numbers in the center box. If, when this number is subtracted from 28, the remaining amount can be divided by the 2 (columns) evenly, then that number should work as a center choice. And the answer to the division problem tells me the sum of each column and middle row.

I started with number I: 1+2+3+4+5+6+7=28 and 28-1=27. But 27 cannot be divided by 2 evenly so I cannot be in the center box. It also dawned on me that no odd number could be used in the center box. 28 minus an odd number will give an odd answer and therefore not divisible by 2 evenly. This eliminates numbers I,3,5 and 7.

I then tried 4: 28 - 4 = 24 and 24 - 2 = 12. Now I had to decide where to place the other numbers. The three numbers in the middle row have to equal I2. We know one of the numbers is 4, so I2 - 4 = 8. The other two numbers have to equal 8. My choices are 5 and 3, 6 and 2, and 7 and I.

(A)

5	4	3

(B)

6	4	2

(C)

7	4	I

I know the columns must add up to I2 also. So, in problem (A) 12 - 5 = 7. My only choice of numbers that add up to 7 and haven't already been used are 6 and I. The only two numbers left are 7 and 2 and they fit perfectly in the right column.

(A)

6		7
5	4	3
1		2

Problem (B) is solved the same way.

The left column: 12 - 6 = 6. The only choice of numbers that add up to 6 and have not been used already in the problem are I and 5. See the figure below.

The right column: 12 - 2 = 10. The only choice of numbers that add up to I0 are 3 and

I		3
6	4	2
5		7

Problem (C) Left column: 12 - 7 = 5. The only choice of numbers that add up to 5 and have not been used are 2 and 3. See the figure below.

Right column: 12 - 1 = II. The only choice left is 5 and 6.

2		5
7	4	I
3		6

My last even number to try is 6: 28 - 6 = 22
22 - 2 = II

I know one of the numbers in the middle row is 6, so II - 6 = 5. The other two numbers have to equal 5. My choices are I and 4 and 2 and 3.

(D)

I	6	4

(E)

2	6	3

I know the columns must add up to II too.

Problem (D) Left column: ll - l = 10. My only choice of numbers that add up to l0 and haven't already been used are 3 and 7. See figure below.

Right column: ll - 4 = 7 The only choice left is 2 and 5.

(D)

3		2
l	6	4
7		5

Problem (E) Left column: 11 - 2 = 9 My only choice of number is 4 and 5. See diagram below. Right column: 11 - 3 = 8 The only choice left is l and 7.

4		l
2	6	3
5		7

I now have three solutions with 4 in the middle, two solutions with 6 in the middle, and one with 2 in the middle. But I didn't continue number 2 out all the way to see if there were any more possible solutions.

Number 2 again: 28 - 2 = 26 and 26 - 2 = 13. I know one of the numbers in the middle row is 2, so l3 - 2 = ll. The other two numbers have to equal ll. My choices are 5 and 6 and 4 and 7. I've already done 5 and 6 in the very first solution so it must be 4 and 7.

(F)

4	2	7

Problem (F) Left column: 13 - 4 = 9. The only choice is 3 and 6. See diagram below. Right column: I3 - 7 = 6 The only choice left is I and 5.

(F)

3		I
4	2	7
6		5

I found a total of seven solutions for Izzie's Problem based on the relationships of the middle number to the sum of the numbers I to 7.

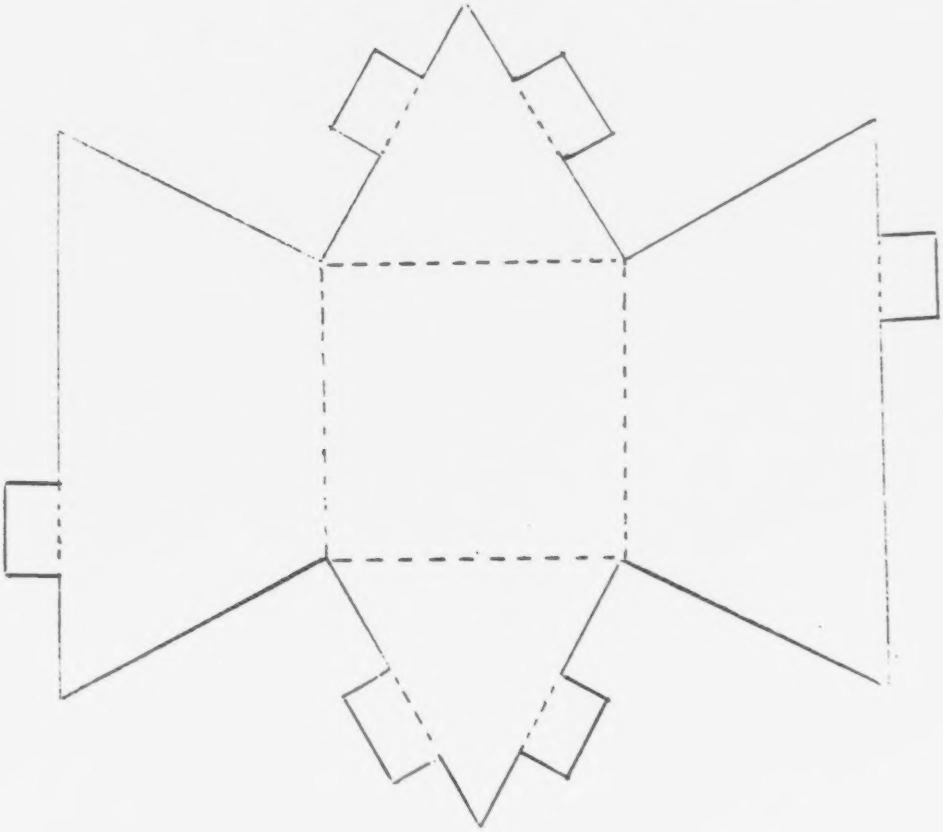
Elizabeth

THE TWO PIECE PUZZLE

Julia Meyer

"Are you joking?" "Two pieces are a puzzle?", I hear you asking. Yes, two identical pieces made from the pattern are a good puzzle. Trace and cut out two copies of the pattern. Tape the tabs in place. See if you can make an equilateral triangular solid from the two pieces. Try it first before reading the clues. Other than trial and error or a bit of luck, how might you approach the problem?

Cut along the solid line. Fold along the dotted line.

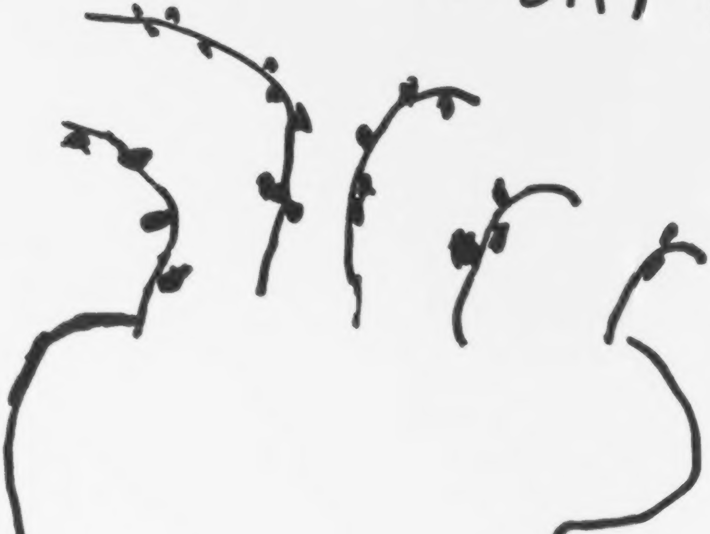


For a logical approach to the problem, consider the following statements.

1. It is a fact that the two puzzle pieces are halves of an equilateral triangular solid.
2. It is a fact that all four sides of such a solid are triangles.
3. One side of the puzzle pieces is a square. How can this fit in?
4. The corners of the square must touch the four sides.
5. The square surfaces must go together.

Why do you think the solution is not immediately apparent? What is it about people's thinking that makes these two pieces a puzzle? The two piece puzzle can be used to examine the properties of an equilateral triangular solid, induce logical thinking, and just have fun.

Robin 5



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ARITHMETIC NOTATION
Bonnie Norman

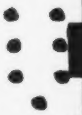
In Learning From Children by Ed Labinowicz, it is suggested that arithmetic notation not be taught until the second grade. He presents some arguments well worth reading and offers standard suggestions for teachers to use at the end of first grade. Since I have been doing my field experience in a first grade classroom in the spring, I was anxious to try these activities with some of the children. These children had been learning to memorize and write number sentences since September.

I began by asking seven first graders to write down 6+3=9. Megan immediately asked if plus was the same as and. LaDonna said it was the same (I wondered what other terminology I would mess up). As you can see by the results of their papers, there were many variations of notation among the seven children. Some even included the same line after the equal sign that is present in most textbooks.

Is it fair to assume that they understand addition as a result of their apparent ability to write a number sentence? I don't think so.

Next, I put four pennies on the table. I asked what I had put down. They all agreed that four pennies were there. I then put down three more pennies and asked them to record what had happened. Each of the seven said that I had added three more and began to count all the pennies by ones to reach seven before recording their number sentence.

I then gave Robert seven pennies and asked him to put them on the table in a pattern that was easy to recognize. He put them out like this.



All of the children counted them by ones. I asked if there was another way to count them.

Maka: "You could count 2, 4, 6, 7."
Tim: "You could count by 3's."
Elizabeth: "How do you count by 3's?"
LaDonna: "3, 6, 9, 12, I don't know any more."

After I reminded them that we had started with seven pennies, I then put down two more pennies and asked them to record what happened. They all went back and counted all of the pennies by ones.

Next I gave Tim 11 pennies to put down in an easy pattern. He lined them by 2's plus 1. All of the children saw the pattern and counted by 2's and one more to get 11.

I then asked Elizabeth to put down 6 more pennies. She lined them up by 2's. I asked if you could also count these by 3's and the unanimous answer was no. When they recorded what was on the table, they all went back and counted by ones.

Jennifer then put out 12 pennies in groups of 2. They didn't want to count those by 3's either. I put down 3 more and asked them to record what happened. The reactions were the same. They all counted by ones to get an answer.

I gave Megan 25 pennies and asked her to put them in an easy pattern. She lined them up by 3's to 24 and put the other penny at the top. No one knew how many there were in advance, so after the pattern was finished; I asked how many pennies were on the table. Everyone of the children counted them by ones and, because of a couple of mistakes in pointing to the pennies, we had three different answers. After pointing out that Megan had put them in rows of threes, I asked them to county by 3's with me. We got to 15 as a group.

I then picked up all 25 pennies to lay out again. I put them in rows of 5 and asked if there was an easy way to count now.

Tim: "It's a square."
Robert: "We could count by fives."
In unison: "5, 10, 15, 20, 25."

I took ten pennies away and asked how many were left. Together, they counted "5, 10, 15". I asked how many I had taken away and again the answer was 15. I reminded them that we had started with 25.
Tim: "You took away 10."
Me: "How do you know?"
Tim: "You took away two rows, so I counted 5 twice."

I then asked them to record what had happened. LaDonna asked if it was plus or take away. I said again that we had started with 25 pennies and had only 15 left on the table. Elizabeth said, "that's take away."

It was wonderful to watch Tim using multiplication without even knowing it to find out that 2 lines of 5 were taken away. From my observations, it appears that a first grader is capable of writing arithmetic notation; but, not necessarily understanding what it means. I am inclined to agree with Mr. Labinowicz that notation could be postponed until second grade. He has so many rich activities in his book to use for teaching real understanding as opposed to memorizing facts and their notation. I know that this involves explaining to administrators and parents why the "normal" sequence of learning math would be changed, but I think teachers should try these activities themselves to support this position. It should not be viewed as teacher incompetence that places notation later in a student's life, but rather an opportunity for children to discover for themselves many numerical concepts and relationships.

Maka 6+3=9 4+3=7 7+2=9
12+3=15 11+6=17 25+10=15

Megan 6+3 = 9 4+3=7
7+2 = 9 12+3 = 15
11+6-17 25-10-15

LaDonna
6+3=9 4+3=7 7+2=9 12+3=15
11+6=17 25-10=15

Elizabeth

$$\begin{array}{rrrrrr} 6 & 4 & 7 & 11 & 12 & 25 \\ +\,3 & +\,3 & +\,2 & +\,6 & +\,3 & -\,10 \\ \hline 9 & 7 & 9 & 17 & 15 & 15 \end{array}$$

Robert 7+2=9 11+6=17
6+3=9 12+3=15 25-10=15
4+3=7

Tim

$$\begin{array}{rrrrrr} 6 & 4 & 7 & 11 & 12 & 25 \\ +\,3 & +\,3 & +\,2 & +\,6 & +\,3 & -\,10 \\ \hline 9 & 7 & 9 & 17 & 15 & 15 \end{array}$$

Lea

$$\begin{array}{rrrrrr} 6 & 4 & 7 & 11 & 12 & 25 \\ +\,3 & +\,3 & +\,2 & +\,6 & +\,3 & -\,10 \\ \hline 9 & 7 & 9 & 17 & 15 & 15 \end{array}$$

LEARNING BY OBSERVING

Terry Lignoul

During my field experience, I was asked to prepare a lesson about Spring. The weather was nice, so I decided to take the students outside. Once outside, I asked the children to find anything that would show that Spring was coming. Art paper was supplied for the children to draw what they observed if they wanted to do so.

After returning to the classroom, I gave each student the opportunity to report what he or she had seen. I was amazed at the reports. Some children had drawn pictures of the buds on the trees. Others had drawn patches of dirt with green grass sprouting through. Those who did not draw pictures chose to tell about what they had seen. Most of these oral reports were about feeling the buds on trees and seeing green grass. The important thing was that not one student in the class failed to report. Without formal instruction, each student had learned.

The point I am trying to make is that children are natural learners. They do not need to be forced to learn. When given the appropriate atmosphere, a child will solve problems and investigate options. A teacher's job -- a teacher's responsibility -- is to enhance learning, not to demand it. In the proper atmosphere, the children will learn and will teach the teacher as much as the teacher teaches them.

WISHES DO COME TRUE

Virginia Small

Have you ever wondered what children in schools around the world learn in their classes and wished you could actually visit the school? I have wondered this quite often and wanted my first grade class to know real children in other parts of the world may wonder what we learn. About six years ago we had the opportunity to correspond with a first grade class in Japan. The children there wrote about their school in the mountains in the city of Fujioka in the Prefecture of Gumma. Samples of their art work were sent along with the translations of what they had drawn.

We discovered the children learn math, science, reading, music, social studies, art, and P.E. They take field trips much the same way we do.

I had the privilege of visiting the school during the month of June. School was still in session. The children there attended school until the middle of July and have a six week vacation at that time. This was a very exciting time as we were greeted at the door of the school and given slippers to wear. Our shoes were left at the door. We were ushered into the Principal's office and served green tea and cookies made of rice and sea-weed. After this, gifts were presented and our tour of the school began.

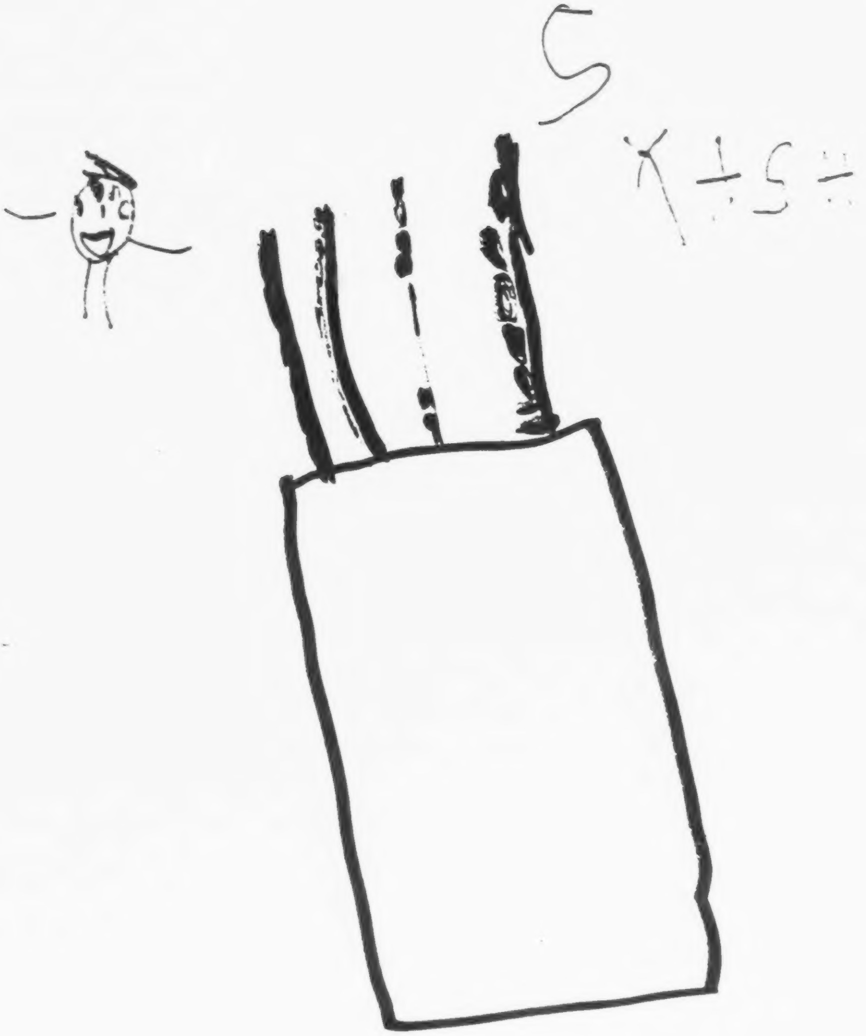
The first grade classes were having an art lesson. The children were excited about seeing us as many of them had never seen anyone from another country. We were interested to note the art lesson consisted of making boats out of noodle tubs very similar to our butter tubs. Clay was used to hold the mast and a sail was made out of paper. There were about 36 in the class with no aides or parent volunteers. Children provide their hand towels as the school does not furnish paper towels. The children had their needed supplies in a bag hanging on the side of their desk.

The other grades were studying various subjects. We would listen a while and move on to the next class. The music room had desk key-boards for each child. At the time we visited the children were listening to classical music. This was a new school and parts had not been completed. They were finishing the library, kitchen and dining area. The kitchen and dining area were for teaching the children some cooking and serving. The children actually had their lunches brought in from another school and all the children ate in the classroom with their teachers. A swimming pool was part of the school and swimming was taught at all levels. I was surprised to note that I didn't see a flag at the school.

The children clean their own school. At the close of the day they clean rooms, halls, floors, and restrooms. There are janitors but their job is building maintenance and furnace care. Perhaps our children would be a little more careful if they knew that their job would be cleaning at the close of each school day.

We also had the privilege of visiting a girl's high school. We met with some of the girls studying English. A few of them were brave enough to speak to us in English and were learning quite well.

I have begun to collect a few simple books from other countries so the children can see what books in other languages are like. Through this interest in other countries I hope to increase children's understanding of other people and their cultures and to accept our differences and appreciate our similarities.



SILENCE IS GOLDEN

Shirley Flath

Is your idea of a perfect classroom one that has neat rows of desks with chairs filled with students sitting erect, hands quietly folded, noggins at the ready to store your words of wisdom, faces adorned with smiles, and wide, inquisitive eyes riveted on the teacher?

Is this the ideal classroom that teachers dream of at night? Would optimal learning be taking place in this type of setting?

One should stop to think how they themselves learn before they teach someone else. And, they must take the time to observe and to see how children learn. What goes on behind those inquisitive eyes that makes outside facts become truly their own knowledge?

Could YOU learn from a tape recorder spewing out knowledge filled with technical terms? Suppose you had no schema to connect that knowledge to make a meaningful whole. You might want to rewind the tape and listen to it again. If you did this, would you want the tape recorder to correct you, or sigh, or give out disgusted looks, or tell you you were not paying attention?

Would hearing the tape over again really help? If you slowed it down, would that help? If you didn't understand the jargon in the first place, does listening to it at a slower pace help to give it meaning?

Would it be better to find someone on your own level who understood the concept to explain it to you in mutual terms? Doesn't peer teaching have value for us? If we encourage questions, discussion, hands-on, and peer teaching, we have lost the sweet silence. But I have learned that silence is golden--not the student's silence but, the teacher's silence.

Teachers are not meant to be founts of knowledge. If we keep spewing out our wonderful knowledge, we run the risk of drowning our students in it. The students may be able to memorize our words to spit them back out on a test, but is that knowledge truly theirs?

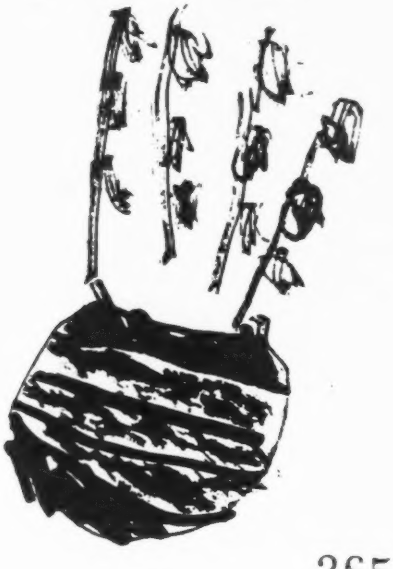
Children must construct knowledge for themselves. They must be given opportunities to experiment, hypothesize, test, verify, and reconstruct things for themselves at their own level to truly learn. In short, students must think, not memorize, to truly understand and learn.

It is an easy task to get students to think. It is amazing to see how easy it is to unlock their minds. A well placed question, a smile, a nod, a little encouragement are the keys to unlock their minds and open them up to think, to soar.

Teachers are not founts of knowledge, but only facilitators of thinking. They are comparable to traffic police. They help children's thinking to flow smoothly and run down the correct avenues.

I challenge you to try silence sometime because as the old saying goes, "Silence is golden."

LiNdSAYN



HATS AND COATS TASK

Aggie Raine

Dr. O'Brien suggested a "child watching" task for the class to do for the next assignment. He told us to show children three coats and four hats and ask them to make as many pairs as they possibly could. I interpreted the assignment to mean hats and coats drawn on paper and cut out to enable the children to manipulate the objects. Another student in the class interpreted the assignment to mean hats and coats drawn on a piece of paper and asked the children to make pairs with the use of a pencil.

An interesting discovery was made. The results were totally different. The children who had the freedom to move the objects made more pairs than those doing the pencil and paper task.

These conflicting results interested Dr. O'Brien, so he asked the entire class to redo the "child watching" task. This time everyone was to do both the manipulative and paper and pencil task with the children. The results revealed that when children were able to manipulate objects, they could make more pairs than when asked to do the paper and pencil task.

We found that most children in kindergarten were able to come up with 8 to 12 pairs (matching one coat and one hat only once) for their coats and hats. The same children, when given the pencil and paper task, could only make three to four pairs. At age l0 most children were successful with both tasks.

Comments:

We were asked to think about what we learned from the assignment. I learned that......

(l) When children are given manipulatives, they are able to make more sense of the task.

(2) When children are told to do something, they often do what is expected and nothing more. By this I mean the children were used to doing worksheets where they were asked to match one object to another. Of course, they're taught at an early age that there's just one "right answer". They were not free to go beyond.

(3) Children may be capable of much more than we imagine.

(4) Schools may be stifling a child's ability to construct reality by asking them to construct knowledge on paper instead of in the mind.

(5) Children are more confident of their ability to think when they have control over the task. The manipulative task allowed them to have control, while the paper and pencil task limited their freedom.

MONEY, MONEY, MONEY

Mary Skaer

"Joe has two dimes, three nickels, and eight pennies. Joe goes to the store and buys one pencil that cost thirteen cents. How much money will Joe have left?"

Typical money problems like the one above are found in most children's math books. The teacher may assign one or more pages of these problems, or discuss them in class.

"Adam, how much did Joe have left," I heard the teacher ask. Adam did not answer. "Adam, did you hear me? Give me the answer to number 3!" the teacher said rather angrily. Adam jumped in his seat, and rapidly put his Garbage Pail Stickers away.

This is an example of what I experienced as I sat watching the fourth grade class during their money lesson. For three days the teacher went through the same routine, fighting to keep the children's attention and interest.

On the third day, I was given permission to work with the children having problems with "making change". The other teacher then took those having problems with telling time.

This was my chance to "shine", and so, instead of talking about Joe who had three pennies and five quarters, we played with money itself. For the next three days, the children would not even touch their math book, for it was obvious that the problems did not mean a thing to them.

"Stephanie, would you like to go to the movies, and how about you Jake?" I questioned. "Yes, yes," they both replied. "Well then let's do."

From then on, they were busy making their own change. Each child was given some paper money, and the fun started. "Matt, what movie would you like to see, and you Heather, what movie would you like to see?" I asked.

"Back To the Future," one replied. So we spent one day buying tickets and snacks and deciding how much money they would receive in change.

On the blackboard we, as a class, discussed what kinds of foods and drinks would appear at the snack bar. Each child made various decisions, bought their snacks, and calculated how much money they would be receiving in change. Each child started off with six dollars, and at the end of the hour, each child shared his results with the group.

As a group, we talked about how important it is to check the change received. We don't want to be cheated out of the money we deserve!

We went to the movies, the grocery store, to the Arch, and to Six Flags in the three days we were together. Each time the children made decisions, and bought items and food. By the end of the three days, they were making change accurately, and understanding much more about money than they seemed to understand when using the textbook alone.

SLIDING TIC-TAC-TOE

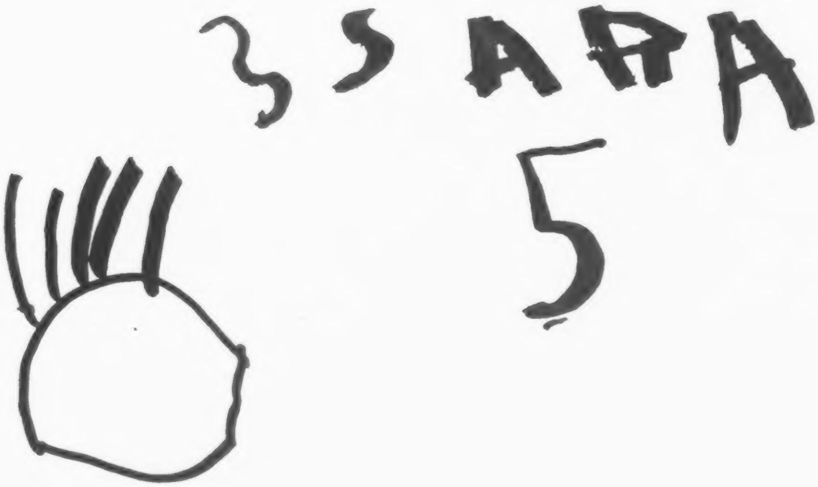
Sharon McCormack

This game is played on a tic-tac-toe grid drawn on oak tag to accommodate the use of checkers.

The players, alternating turns, place their checkers one at a time on the grid trying to get three of the same color in a row -- either horizontally, vertically, or diagonally. If there is no winner, the checkers can be rearranged one move at a time. A move can consist of removing or moving a checker. Jumping opponent or self is allowed.

Another way to play is to allow all the moves previously mentioned from the very beginning of the game. After the students have played several games, let them establish new rules for playing a different way.

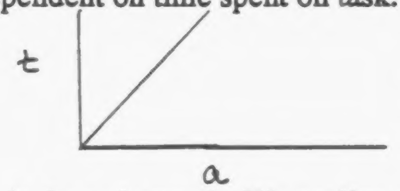
This game was taught to me by a teacher friend with whom I had the pleasure of working.



LEARNING DIMENSIONALLY

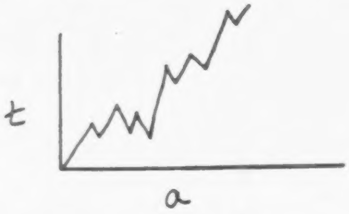
Teena Townzen

The definition of learning as a growth of knowledge is acceptable. But this only scratches the surface of the concept of learning. Everyone agrees knowledge or learning is continuous. Learning may occur in directions that are unnecessary, but it does occur. At first, we could consider the amount of learning is dependent on time spent on task. (fig. 1)

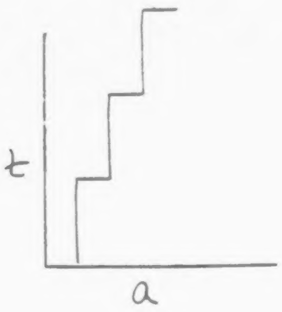


This does not always happen. Some activities can be rich in learning and low in time spent at the activity.

Our thinking is then changed. We realize activities can be low in productivity. (fig. 2)

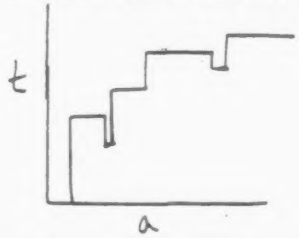


But are these points of low productivity, so sharp and short or are there plateaus of learning? (fig. 3)

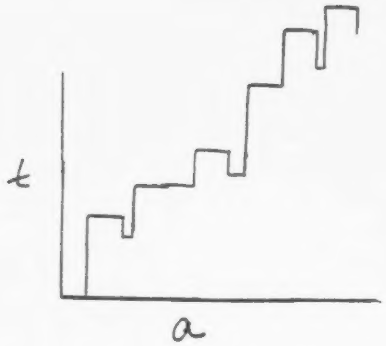


The next step would be analyze the plateaus. Why do they happen? When do they happen? Does the learning increase after a plateau or decrease? These questions, when answered, can give a good impression of what learning is.

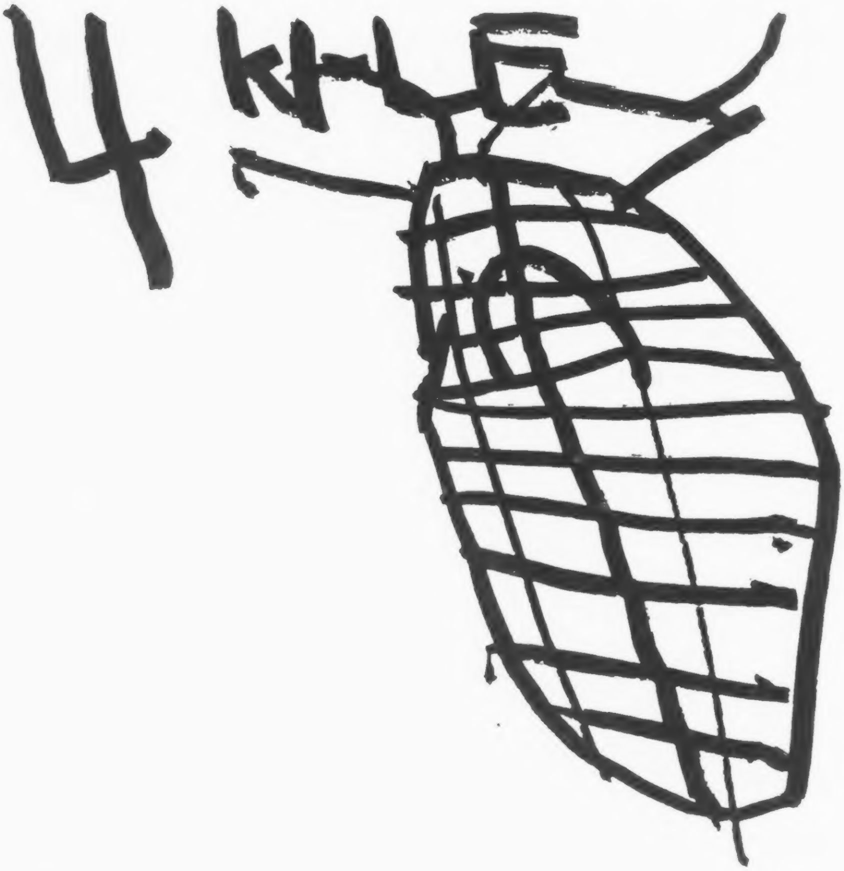
A plateau may only be a time when learning upwards is complete for that period of time. Since it has been agreed learning is continuous and, at certain times, learning cannot continue upward, it must continue in other directions.



Children, at times, need to learn in ways we could not graph two dimensionally. A child can grow socially and physically. There are times in a child's life when he or she needs to grow in other directions before they can move up the stairs. Sometimes children take more time on these plateaus before they can grow. Or they may hit their plateaus quickly. One time easily discernable is puberty. Some children go through the stage quickly, others slowly. At this time, they are not ready to move on in one way until they have expanded their knowledge in other ways. (fig. 5)



Learning is now explained in understanding the expansion of knowledge in more than one direction. The rate is different for each child. The expansion is not orderly or neat. Before moving up, children need to expand in other directions and not always to the same degree. In conclusion, learning is growth in many directions and not always in a regular manner; nor easily seen until later in life where the knowledge is needed.



SOLVING PROBLEMS WITHOUT NUMBERS

Eileen Long

In the past, there was a need for a great number of people who were trained in accurate calculation. Little knowledge was needed beyond the accurate application of preconceived solutions. Today, and more so in the future, the demands are quite different. Our calculators and computers have taken the drudgery out of calculation and have placed a higher value on a person's ability to select a process, invent a solution, and devise a strategy.

A child needs sufficient time to explore problems, to invent solutions, and to internalize processes - placing the emphasis on higher level thinking skills. Calculation skills, such as estimation, which a child acquires during problem solving could be developed as part of a useful thinking process, rather than as an isolated, linear skill.

Many times, math anxiety will develop in a child because he lacks computation ability or has not yet developed the ability to think logically. Since computation has its foundation in logic, the emphasis must be on logical thinking. Taking the numbers out of problems is a way to promote this logical thinking without a negative reaction from math-anxious children.

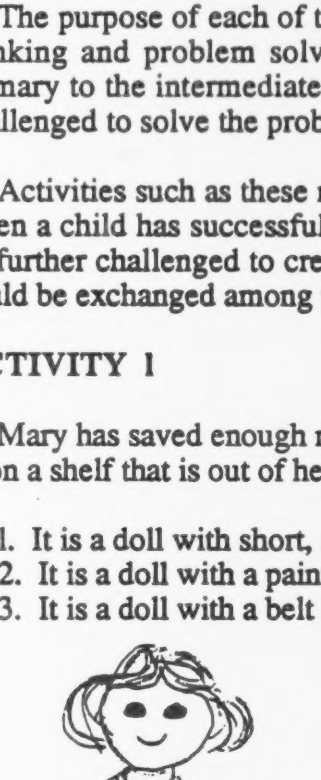
The purpose of each of the following activities is the development of logical thinking and problem solving strategies. They range in difficulty from the primary to the intermediate level. Rather than computing an answer, a child is challenged to solve the problem (a definite difference).

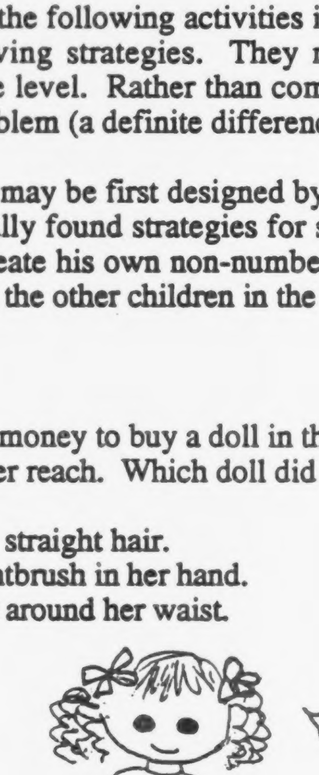
Activities such as these may be first designed by a classroom teacher. Later, when a child has successfully found strategies for solving the problems, he can be further challenged to create his own non-number problems. These activities could be exchanged among the other children in the class.

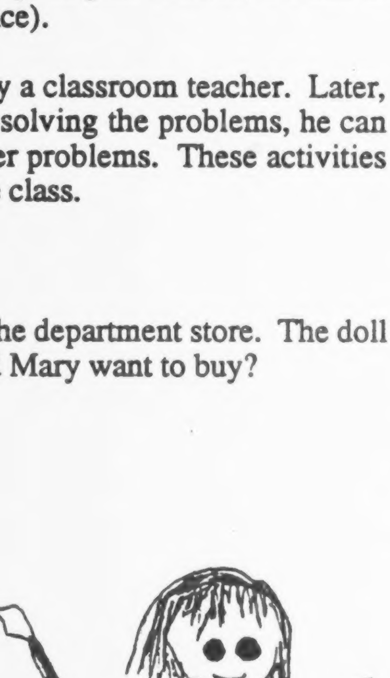
ACTIVITY 1

Mary has saved enough money to buy a doll in the department store. The doll is on a shelf that is out of her reach. Which doll did Mary want to buy?

1. It is a doll with short, straight hair.
2. It is a doll with a paintbrush in her hand.
3. It is a doll with a belt around her waist.







ACTIVITY 2

Each of the Smiths' children has a favorite snack and drink. Mrs. Smith is packing a picnic lunch and needs to decide what each of her children likes. Read the clues and help her decide.

1. One child who likes Kool-Aid also likes pretzels.
2. Sue loves sugar cookies.
3. Mike's favorite drink is not soda.
4. Kim would rather not have Kool-Aid.
5. The child who likes potato chips does not choose orange juice as the favorite drink.
6. David likes milk.
7. Soda and ice cream are this child's favorites.
8. One of the boys is crazy about potato chips.

NAME____

DRINK_______________________________________

SNACK_______________________________________

ACTIVITY 3

Four schools enter a swim meet. Team members of each school wear their school colors. Find out each school's colors and how they finish in the race.

1. Russel always beats Rosewood.
2. Green Trails color is not blue.
3. Rosewood's school color is purple.
4. Highcroft has on red uniforms.
5. No one comes in after the team that is wearing purple.
6. The yellow team comes in between Highcroft and Russel.
7. The second placed team loses to Highcroft by a slight margin.

PLACE______1ST_____2ND_____3RD_____4TH___

SCHOOL NAME______________________________________

SCHOOL COLOR_____________________________________

These non-number problems allow a child to use and improve the techniques and strategies that have worked well for him. They are activities that encourage resourcefulness, self-confidence, independence, patience, and competence. They allow a child to feel good about himself.

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INTEGRATION OF CONTENT AREAS

Candie Wells

Teachers' Center sessions, an article by E.A. Osborn, and my own field experience have sparked my interest concerning integration of content areas. This interest began with Dr. O'Brien's discussion on viewing knowledge as a network of ideas. He suggested that this network of ideas is obtained by action, and that action generates new knowledge. A network of ideas cannot be created by having 40 minutes of reading followed by 40 minutes of math and 40 minutes of science, because in 40 minutes of basal reading, 40 minutes of math drill, and 40 minutes of "open your science book to page l22," there was no action or doing by the children. There are two problems here: l) No action by children and 2) A splintering of ideas into separate, mutually exclusive, compartments.

While reading an article by E. A. Osborn I began to see how the integrated day might generate the action and doing needed to create a network of ideas.

Osborn warns us to be careful not to change too much too fast, else comes teacher and student insecurity. Teachers must begin by developing a philosophy conducive to open-ended learning situations.

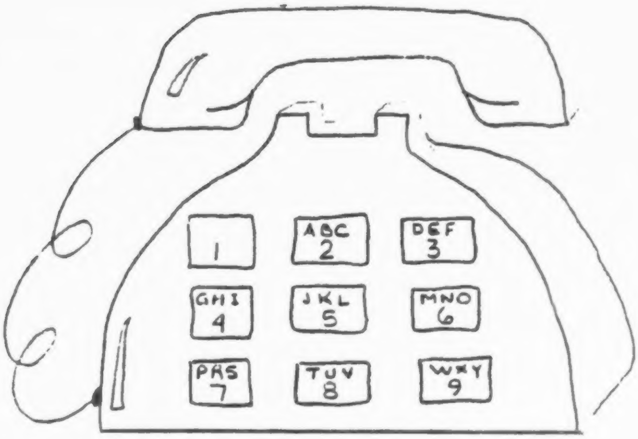
Osborn offers a couple of possibilities for getting started with an integrated day. One of his suggestions was that we give a small part of the day, maybe only an hour to begin, to discovery learning. Another option is to begin with what he calls "Cellular Development". (A group of four to six children who share a particular interest develop and work on a project related to that interest. When the teacher feels she and the class is ready, another group can be formed parallel to the first.)

During my field experience, I had the opportunity to take a small step toward integration in some content areas. It began with a science assignment to conduct a consumer research project. I also wanted to teach another language arts lesson but I didn't want to ask for another block of time. I began thinking about O'Brien's lectures and Osborn's article. There was the answer -- Integrate the lessons! The consumer research project already included some math and science. Now it was time to add some language arts experiences. I decided on writing magazine advertisements. After the completion of the consumer report and some brainstorming, the children wrote and illustrated their own advertisements for the product of their choice from Consumer Report. What started out as a science assignment turned out to include math and language arts experiences as well as the weavings for a network of ideas. It was a small start and it worked!

If we look at what we're doing in the classroom with an eye for weaving ideas from different subject areas we are studying, we could find the beginnings of an integrated day. At the end of an integrated day a child can look back and see his work, what he thought was important. Allowing the child to do his own work and see its importance and coherence should be all the reason we need to start integrating the "lessons" we ask him to engage.

TELEPHONE NUMBER ANAGRAMS
Karen Haas

I gave the following "assignment" to my class.



Can you decode the telephone numbers listed and find out where I've called this month? Solve each number by substituting a letter for each numeral. (Remember there are three possible letters choices for each digit.) I've given you clues.

Example: 835-374-6637
TEL EPH ONES

1.	972-446-4866	A museum named after our first leader
2.	366-253-3825	DisneyWorld
3.	387-236-8726	A recorded message from my daughter's favorite rock group
4.	624-424-6873	The location of our next field trip
5.	277-537-8673	A computer place
6.	786-637-8643	City parks and recreation
7.	765-423-3378	Everyone's friend
8.	288-673-7247	My mechanic
9.	767-377-6737	A local flower shop
10.	834-382-2537	The produce stand

GOOD LUCK!

Remember -- there can be other answers - different from mine. All are welcome! What about your telephone number? What does it spell?

TELEPHONE NUMBER ANAGRAMS
(Answers)

1. Washington
2. Donald Duck
3. Duran Duran
4. Magic House
5. Apple Store
6. Summer Time
7. Police Dept.
8. Auto Repair
9. Roses Roses
10. Vegetables

DISCOVERING THE TENS PLACE
Jo Ann Williams

Eight sixth grade remedial math students were asked to do a series of tasks. The students ranged from eleven to thirteen years of age. Of many tasks, three were chosen to be described in this paper:

1. Counting forward by 10's starting at 34.
2. Reading the numbers 342, 243, 432.
   a. Extended by: "What does 3 stand for in each?"
   b. Write the number that is 1 more than 342.
   c. Write the number that is 10 more than 243.
3. Computation using addition algorithm:
   37
   +28
   And then:
   a. Tell me how you worked it out?
   b. What does the "1" stand for?

These three tasks were chosen because they shed light on how the eight sixth graders perceived the ten's place. All were able to do the textbook algorithm 37 + 28. Yet explaining the tens place was not possible for over half of them in two of the tasks and almost half in one.

Individual interview observations were conducted using a tape recorder and with observer taking notes.

RESULTS	NOT ABLE	ABLE	
Task #1	75%	25%	
Task #2	---	100%	
Task #2a		---	100%
Task #2b	12.5%	87.5%	
Task #2c	25%	75%	
Task #3	---	100%	
Task #3a	---	100% (Using "1" as describing what they carried.)	
Task #3b	62.5%	37.5%	

These were shocking results considering they were sixth graders ranging from ages eleven to thirteen, even though they qualified for a remediation program. All the students who could not count forward (Task 1) were given extension activities before going on to reading numbers (Tasks 2, 2a, 2b, 2c). These activities were such that the students had the opportunity to discover how to accomplish counting by tens starting from 34. (My instinct to teach took over here.) For example, the students were given popsicle sticks, some in groups of tens and some loose. These students were encouraged to use the sticks in any way they wanted to help them count forward by tens from 34. Half of the students did discover this; of these, one said he had never worked with manipulatives.

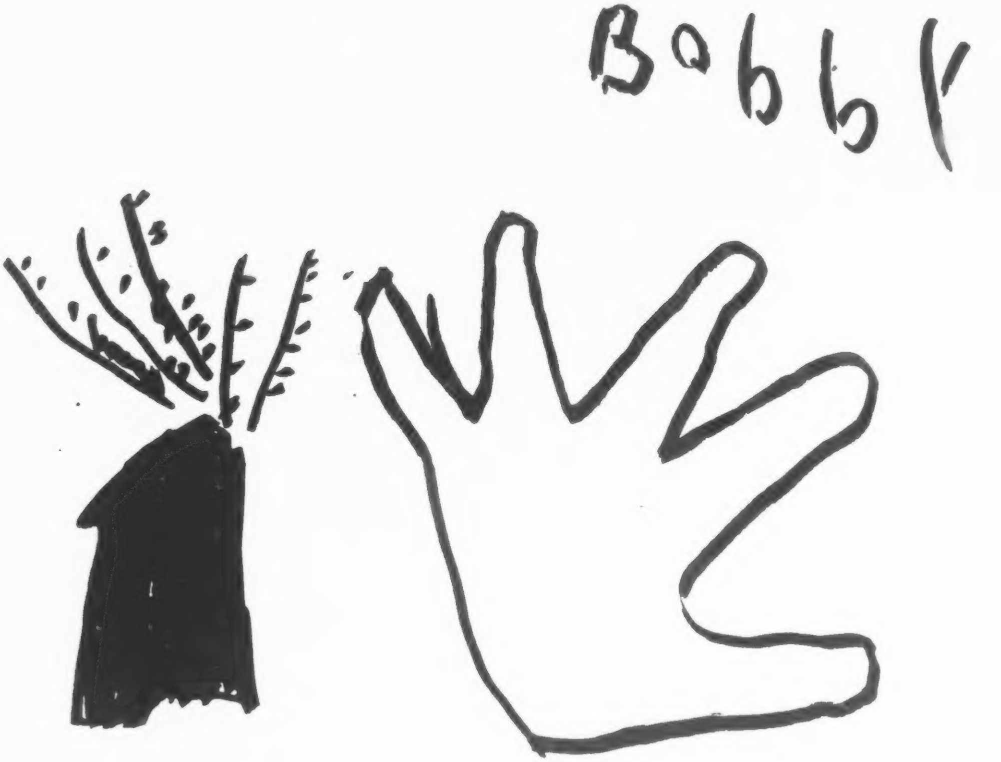
Students who could not count forward (Task 1) said 34 was not a ten number, therefore you could not count by tens.

In Task 2 (reading numbers) and Task 2a (What does the 3 stand for?) the students' responses appeared to be the result of textbook presentation and memorization rather than real learning. For example, one student who stated it was impossible to count by ten from 34 could not count accurately from 199. (An aside thrown in for fun.) This student, as well as all the rest, were able to answer "What does 3 stand for in each?" Yet over a third of the students could not write the number that was one more or ten more (2b, 2c).

For Task 3 (the textbook algorithm) 100% of the students computed accurately They all explained their computation using "1" when describing what they carried. Over half of these students responded that the "1" stood for one, not ten. These students stayed with this explanation even when showed one group of ten sticks and one stick.

Having students perform problem solving tasks while observing with minimal interruptions prove to be a valuable diagnostic tool.

The students' errors give information as to where the student is in his understanding of various concepts. Specifically, students' performance on the three tasks showed a wide variation in their understanding of place value. Some are in need of simple counting experiences with manipulatives before they will be ready to proceed to tasks dealing with place value. Others are well on their way to discovering place value.



THE INVASION OF THE PLUTONIAN

Kathy Paul

A Plutonian crashes on earth near an elementary school. He is unhurt and walks to a window in the school to peek in. What would he see? Well, we all know what excellent observers Plutonians are so he can observe many patterns. But he does not know Earth languages and therefore can't understand what people are saying. The Plutonian can only observe their behavior and draw his own conclusions.

The little beings seem to sit for most of the time. They are in neat rows with a large being sitting in front. They spend much time marking in blanks and putting circles on printed sheets. They perform a ritual where they raise their limbs every so often. For some reason, the big one doesn't take part in this. The big being seems to account for most of the spoken language in the room. The Plutonian hears a spaceship approaching and he must leave. He hopes to visit again sometime.

This is what an uninformed observer might see in an elementary classroom. People who work in schools sometimes overlook conditions that would be obvious to someone who has never seen a school. We must put ourselves in that position every so often so that we may gain a new perspective on what is actually happening. Maybe the next time the Plutonian visits, he'll have something better to report.

GETTING LARA, 4, A BRIGHT GIRL, INTO SCHOOL

Frederick H. Weibgen

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(Weibgen is an official of the United Nations Food and Agriculture Organization. This article, which appeared on the op-ed page October 20, 1985, is reprinted with permission of the New York Times.)

TEANECK, N.J. -- Discovery: Our pediatrician tells us that our daughter, Lara, who is 4 years and 4 months old, seems abnormally bright. "Have her tested," he recommends. The test shows that her I.Q. is 154. The psychologist says this I.Q. occurs in two out of 10,000 people her age. He says she's about at second- or third-grade level. He also says she's mature, emotionally speaking. It is June 1985.

Reverberations: At first, there is parental vanity. My child, the genius. Then wonderment, then humility (why our child?), then the weary feeling of a trustee, not just of this child's fate but of creations' marvel. How to do right by her? And by it? As a first step, we decide to enroll her in kindergarten. It is July.

Preliminaries: Lara being our first school-age child, we have everything to learn. We learn that the school system in our community, Teaneck, N.J., is considered first-rate. We learn that there's even a gifted-child coordinator. We meet with him. Everything sounds encouraging. Lara will join kindergarten shortly, we feel. It is August.

More preliminaries: We're told of a policy -- the minimum admission age for kindergarten is 5 years of age. Lara being younger than that by a few months, we ask: Is the policy immutable? Or is there room to accommodate an unusual case? There is, we're told -- it's just that never before has the Board of Education made an exception. The occasion to ask for such an exception is the board's new public hearing, in early September, advises the board's secretary. Later, she calls back: Would we please not divulge to anyone that she told us about the board's public hearings? We worry: Will the System, do right by Lara? It's late August.

Formalities: We write to all board members to consider a waiver of the "5 years old to enter kindergarten" policy in the case of Lara Weibgen, supporting documentation and transcript of I.Q. test attached. We have several positive telephone conversations with the board president. We are hopeful. It's early September.

The public hearing: We ask the board to waive its policy because, statistically speaking, Lara is the one child, out of a total local school population of 4,000-plus, to have the kind of I.Q., because she's plenty mature and sociable, because any general policy is only as good as the exceptions it allows for. We mustn't sacrifice an individual child on the altar of general policy, we say, getting somewhat emotional. Board members look cheerfully noncommittal. The matter is to be taken up in executive session. It is post-labor Day.

Reverberations, Part II: We are bewildered. Why were there no informed, or curious, or compassionate, or, for that matter, any questions about out child? And what of the broader educational challenge of integrating an exceptional case into the existing structure? If that cannot stir the Board of Education into action, then what can? How much of a handicapped child is a gifted child, we wonder? Frustration sets in.

Private sessions: We invite the school superintendent for dinner at our home. There's purposeful cunning involved: We want to feel him out, but also, and straightforwardly, we want to learn what exactly the board feels it needs to make up its collective mind. Between coffee and Benedictine, what's required is revealed to us: An in situ observation of Lara in a class context is required to ascertain her capacity for integration, as well as a further I.Q. test and a further maturity test. Pedantic as the process strikes us, we are reassured: Things are moving. By the way, its mid-September, and the evening is positively enjoyable.

The tests: The school superintendent assembles, on one day, in one place, on one side, and for the one purpose of establishing Lara's fitness for kindergarten: the gifted-child coordinator, one psychologist, one social worker, one handicapped-children specialist (!), the principal of Lara's prospective school. On the other side is Lara. Tests and observations are carried out until our child is overcome by fatigue. The outcome: Lara is found ready intellectually, emotionally, physiologically to join kindergarten. Indeed, it is said that she's at the level of third- or fourth-graders.

The finale: Lara is not admitted to kindergarten. The team of experts determines that kindergarten isn't right for her, is beneath her developmental level. Put her in private school, the public school officials counsel. It is late September.

Reverberations, Part III: Quo vadis, Lara? The System asks you to prove you're ready to cope with it. You do -- you are. Whereupon, the System tells you it isn't ready to cope with you.

Postscript: Lara is going to be enrolled in a private school in Englewood.

WHERE IS OUR ENQUIRY?

Jana Butler

Throughout the book, THE ENQUIRING CLASSROOM, Stephen Rowland discusses his observations of a very unique classroom. In THE ENQUIRING CLASSROOM, the children are given tremendous freedom and encouragement to learn. I was amazed at the amount of creativity and curiosity these children possessed. The children I watched seemed so immature and much less creative. The more I read, the more intent I was on figuring out why these children were better able to delve into situations and experiences without worrying if they were doing it correctly.

Rowland discussed a lovely situation with a boy named Ian. Ian was given potato sticks and potato crisps and he was told to do anything he wanted with them. Ian proceeded to build an old fashioned sailing warship. He didn't hesitate or look questionably at the teacher. Ian attacked this task and had great success. I was amazed at his imagination and intensity to get that warship to look exactly the way he wanted. Ian was just one example of the children throughout the book. I don't believe the children realize they are actually learning when they attack the experiments given them, but they do learn. They will let nothing stand in the way of their challenge. I tried to do a creative experiment with some of the children I've been observing. I chose a six year old and a nine year old and gave them crayons and popsicle sticks. They looked at me in puzzlement when I told them to do anything they wanted to with the crayons and sticks. The two boys just fiddled around with the sticks and crayons until I suggested they might want to build something or make a picture. I was very disappointed with the results of my "creative" experiment.

The question I ask myself is, is it possible teachers do something to children to stunt their creativity and imagination? I'm sure younger children would have had no problems with sticks and crayons. It is a shame a six and nine year old had questions about playing with these items.

Structure, Structure, Structure, we stress it so much. Could too much structure be damaging to a child? I'm beginning to think it might. Even when children go to an art class their creativity is knocked down. They have to follow structured directions. If they don't, they get marked down for it. This is so sad, because then, when children are asked to be creative, they are utterly lost.

We as teachers should put forth an effort to let children create and imagine all they want. We should support any and all their efforts at creativity. If we don't make that effort, children will always be dependent on their teachers or an authority figure. Our responsibility should be to make children independent adults, instead of dependent babies.

WASTING TIME

Edna Pyle

What if you were given a task to do five days a week which is routine and unenjoyable? Why do teachers subject students to this sort of thing on a regular basis?

From my field experience in two classrooms, I saw math textbooks and workbooks shoved in front of students' faces day after day. What resulted was rote memorization, disinterest, and boredom. Children were not allowed the opportunity to relate math to the real world. Does an engineer practice his profession merely by memorizing data, or by applying processes and principles and data to real situations?

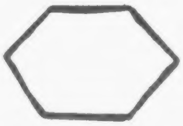
Wouldn't students learn more by problem solving, manipulating, and relating concepts to their real life experiences? Why not give a child five objects and ask how many combinations could be found to get the sum of five? (How many would there be? Generalize.) Wouldn't this be more meaningful than having a child memorize $4 + 1 = 5$, and so forth?

Teachers complain that this type of active learning is time consuming. I suggest that it is more efficient. What is understood will stay with a student. What is memorized won't.

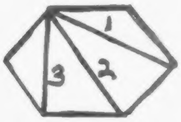
DIAGONALS

L. Hoeke

I Recently worked with a sixth grade math class. They were studying geometry and while we were grading an assignment we came across a problem for which the students had found several answers. The students were to find the number of diagonal lines in a six-sided figure.



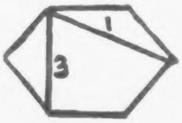
I drew this figure on the board. Then at the students' instruction I drew these lines.



One student said "Hold it, that's (the third line) not a diagonal." The other students told me to ignore him, that he was just being a trouble-maker. Personally, I was fascinated at his originality. He might be a "trouble-maker", had my bet is he sincerely thought that a diagonal line could not be vertical. I pursued the issue, "You mean this is not a diagonal line?" I asked, still referring to the third line.

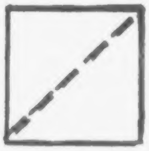
He responded, "No, it's a vertical."

"But isn't it the same angle as this (the first line drawn)?"



"Yes, it is, but it's vertical. Up and down. He was emphatic about this.

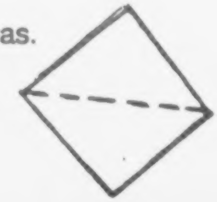
I tried several different shapes on the board but I got the same response. To some of the other students this was exasperating because it was obviously the same line just shifted a little. Finally, I had one of the students find a square sheet of paper, on which I drew a diagonal line.



"Is this a diagonal line?" I asked.

Several students, including the boy I was working with, said it was.

"What if I turn the paper this way?"



"Now, it's vertical." He stated with all sincerity amidst all the statements to the contrary.

One student volunteered that a diagonal line always goes from one corner to another no matter what the orientation of the object or the direction of the line.

Faced with the disagreement of most of the class, he finally agreed with them, but I don't think he really changed his mind. He seemed to feel that as long as the line was not straight up and down it was diagonal, but a diagonal line could not be a vertical line. The fact that it was the same line did not bother him at all. (I now wish that I had tried horizontal lines also.)

One additional observation: He also stated that the last figure could not be a square, it was a diamond!

Have other teachers run across this issue with kids?

MAURICE AND HIS HIDDEN CHIPS

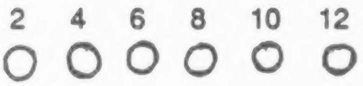
Susan Cobb

Everyone affiliated with the Teachers' Center should be familiar with the Hidden Chip game--presenting a number of chips to a child, hiding some of them and then asking the child how many are hidden. Well, I had one very interesting experience playing this game with a second grader named Maurice.

One afternoon I took Maurice aside and presented him with six chips. I then went on to hide three of the chips and asked Maurice how many were hidden. He correctly told me three after a couple of seconds of thinking. I then decided to pick a larger number of chips to work with. I grabbed a handful and Maurice counted out a total of 32. I went about the regular shuffling of the chips, asking Maurice to close his eyes, and hiding a total of 12 chips. Maurice had a bit more trouble with the larger number of chips. He guessed, he estimated, he made up his own equations, he used more chips, he did just about everything to come up with the correct answer. The following is a brief recap of what happened with the session with Maurice:

Examiner (E): "Maurice, how many chips do I have here?"
Maurice (M): After counting the chips one by one, "32".
E: "Okay, close your eyes and let me mix them up. Then I'll hide some." After mixing and hiding 12 chips, "Okay, you can uncover your eyes. Maurice how many chips did I hide?"
M: "Looks like about 10."
E: "Are you sure?"
M: "No."
E: "I need to know exactly."
M: "I don't know." He went on to count the chips that were still visible.
E: "Would it be helpful if we used marks?"
M: "Yep--give me some paper."

Maurice went on to put down marks as he counted up to 32. However, he was pretty careless and ended up with 34 marks. He then went on to discover that he made too much of a mess with the marks. He decided to use circles instead. He went on to draw little circles on the paper (a total of 33 this time). He began to number them. Once again his numbers started to run together and he didn't know what circle he was on. So he decided to try again with the circles, only this time he had a different strategy: He was going to count by two's. In Maurice's own words, "It's quicker that way!" Here is what Maurice actually did though:



He was counting each individual circle as being 2.

M: "This isn't working. Can I do something different?"
E: "Sure, Maurice. You can use anything you want."
M: "Okay, I'm going to get my own chips." He proceeded to count out 32 chips. "Okay, now I count these (the leftovers)."

But Maurice still didn't tell me the amount of chips that I had hidden. Instead he turned to the paper and wrote 12 + 20 = _____

E: "Maurice, now what's this you have written down?"
M: "Oh, that's not right." He scratched it out.
E: "No, Maurice, just keep that there. Let's go back to the chips. How many do you have?"
M: "32"
E: "How many did you take away?"
M: "20"
E: "How many do you have left over?"
M: "12"
E: "Then what's the answer to the problem you have written down?"
M: "32 and you have 12 hidden underneath your hand."
E: "Are you sure?"
M: "Yep, positive."
E: "Do you want to count them just to be sure?"
M: "No. I don't need to because I know I'm right. You have 12 underneath your hand."
E: "Okay, Maurice, I'm not going to show them to you at all."

I went on to put all the chips back into the box together and Maurice never doubted the fact that he was right.

THE NEW BREED OF TEACHERS????

Renae Pontious

During a recent elementary teacher's methods course I was able to observe twenty-one future teachers. Most of the students were elementary majors, although a few were special education majors. The assignment was for each future teacher to develop a fifteen to twenty minute lesson plan in the academic field of their choice. Behavioral objectives and an outline were handed out as the lesson was conducted.

Since, in a normal situation, one does not have three or four weeks to prepare for a single lesson, one would expect this to be a well planned example of the would-be teacher's best and most creative efforts. This exercise counted as ten to twenty percent of each person's grade. If these are their best efforts, our children's futures are not very bright!!

There were twenty-one lessons presented over a three-day period. Ten lessons consisted of the teacher giving a verbal lesson after which the students were asked to write something to be graded. Two of these lessons were math, one science, and seven were language arts.

The next group of lessons (two math, one science, and one language) consisted of another verbal lesson accompanied by a ditto worksheet. Two of these dittoes were so badly copied they were practically illegible. One of the dittoes, for first grade math, had three ducks--two on the left and one on the right--separated by a frog holding cards. Four animals, right? Wrong! 2+1=3!! All of the students in this group got their ideas directly from the teachers they were observing from Field Experience.

Finally, seven lesson plans (one-third) consisted of hands-on learning experiences for participating students. All of them were creative, and the teachers giving the lessons seemed excited by what they were presenting. The majority of these student teachers were Special Education majors and none of them did their teaching observations at the same school as the "ditto teachers".

It would appear that Special Education majors are taught to individualize programs for their students. They are taught to make their own materials and do whatever it takes to help the student learn. They are taught to use all the senses to help the child process what is to be learned. Hands on is highly suggested no matter what the subject matter.

Are our "normal" population of students less worthy of the same techniques? With the advent of workbooks, ditto machines, and specialized music and art classes, we have begun to breed some very lazy teachers, and thus lazy students who wait to be fed information. Our new student teachers are not seeing creative teaching in the classrooms where they are observing. Instead they are learning to arrive at school earlier in the morning to have first access to the copying machine.

I polled twenty elementary majors as to what they thought of these lesson plans. Three-fourths of these students saw nothing wrong with them. They felt the lessons were "realistic practice for what you really do in the classrooms. "Who has time for all of that creative junk?" and "You can't keep coming up with those things every day" were typical responses. Many of the students were under the delusion that if the school had basal workbooks they were mandatory. The school sets up the curriculum and the teacher passes out the dittoes and worksheets. One teacher-to-be even thought the principal sat around listening in over intercoms, using gestapo-like tactics, trying to nab a teacher whose lesson plans did not include the prescribed worksheets. Is it any wonder parents and others feel the teaching profession is over-rated? Have we been reduced to paper passers?

Classes in elementary instruction should emphasize creativity more. Teachers already in the field are examples to student-teachers and observers. Are they aware of the example they are setting? Are they living up to the ideals they had as student teachers? Do they want other teachers to emulate these behaviors? A teacher in this position is not just affecting her own students and student teachers, but hundreds of future students of his or her trainee. For their sakes there needs to be changes.

AN ESSAY

Shirley Ann Cogan

I taught with Shirley for a number of years and marveled at her uncanny ability to choose the child most in need of a special lift to befriend. I saw her work wonders with a number of children and, when I found she had written an article on the subject, I knew I had to share it in SEEDBED. Thanks to Shirley for letting me print this here and to Dr. Rebecca Glenn, Lindenwood Colleges, St. Charles, for encouraging her to write it. --

Barbara Goldenhersh, editor

The wonderful and often extremely difficult paths that the minds of young children follow have always fascinated me. Because I am a compassionate, very free and loving elementary school vocal music teacher, many times I observe and experience totally different intelligences in a child than his or her academic classroom teacher observes and experiences.

One of the books on my reading list this semester was Frames of Mind: The Theory of Multiple Intelligences by Howard Gardner. Dr. Gardner is associated with Harvard University, the Boston University School of Medicine, and the Boston Veterans Administration Center. He is a leading psychologist who believes that everyone possesses at least seven intelligences, most of which have been overlooked in our testing society, and that each person's blend of competences produces a unique cognitive profile. An important claim of his theory is that each intelligence is relatively independent of the others, and that an individual's intellectual gifts in, say, music, cannot be inferred from his or her skills in math, language, or interpersonal understanding.

Not only has this book enabled me to observe and interact more beneficially with my students and my colleagues, it has had a profound effect on my perspective of my own intelligence. I have grown up thinking that I was hopelessly stupid because math and science courses held little or no interest for me. My attempts to understand their basic tenets, in such courses as algebra, geometry, and biology, were doomed to disaster. And, of course, the whole affair was made more devastating by the fact that both my father and my sister were brilliant mathematicians.

During thirty years of teaching music, it has been one of my primary goals to seek out the children and adults who have been by-passed somehow by these intelligence-giving life forces --- math and science --- and to try to make their lives less painful. After all, they, too, knew that they were stupid: all the intelligence tests kept saying so. Here is an example of my search for these children; all names are fictitious.

At the conclusion of each school year, I present an all-school songfest. There are approximately 650 students in my school, and the songfest is an extremely happy, musical evening for the entire family --- grandmas, grandpas, aunts and uncles, moms and dads and babies. The audience is very large --- from 600 to 1,000 people. Each of the thirteen songs presented that evening has from two to ten songleaders at the microphones and several other children playing instruments. These songleaders and instrumentalists are chosen from the entire school population (K-6). Each songleader must manifest a very large portion of self-confidence (musical self-confidence and personal self-confidence). Each one must possess that intangible quality, CHARISMA. Each one must be able to communicate immediately with a hugh audience, with nothing to prepare them for the nerve-shattering impact of performing for l,000 people. DEAR HOWARD GARDNER, HOW ABOUT THAT FOR INTRAPERSONAL AND INTER-PERSONAL INTELLIGENCE?

As usual, most of my STARS came from the percentiles much closer to thirty than to ninety-nine. Before the songfest two years ago, when the list of my STARS was sent to each of the faculty, their astonishment was overwhelming. Some members of the faculty commented, "These children can't even do their HOMEWORK!" And, "These children DON'T KNOW THEIR MULTIPLICATION FACTS!" And, "These children are in my LOWEST READING GROUP!" One teacher even went so far as to say (with a good deal of raucous laughter punctuating the sentence), "Shirley, is this your idea of a remedial songfest? Almost every kid on this list is either a discipline problem or has a really low I.Q." (I almost expected someone to say that my children didn't know their lessons on EGYPT or FLAX.)

Because it is such an honor to be chosen as songleader for the entire school, each of these students receives a great deal of attention from the principal, from the faculty, and from incredibly proud parents and relatives. The classroom teachers often begin to see heretofore unnoticed capabilities emerging as the child's more positive self-image asserts itself. Gardner says that the idea of multiple intelligences is an old one. What he hopes to establish is that multiple intelligences is an idea whose time has come! I HOPE SO TOO!

His chapter on musical intelligence explained some things which have puzzled me for years. For instance, in my student-teaching days at a settlement house in St. Louis, there was a teenage student who came weekly for piano lessons. Bennet's only communication with the world outside of music was the one word, SHAZAM. He would come swooping into the room, arms outstretched like an airplane, yelling SHAZAM. It meant hello, goodbye, I'm hungry, I'm thirsty, let's get started! —– an all-purpose word, SHAZAM! He could not read language nor could he read music, and he seemed to have no abilities outside of music; however, when he sat at the piano, he was transported to another world. Bennet loved classical music and with only one hearing of a movement from a symphony, he could simultaneously transcribe the orchestral arrangement for piano and play with technical ease and expression. Perhaps this was an example of the "idiot savant" which Gardner writes about.

On the other side of the balance scale are the children who are considered to be gifted. Many times they are either satisfied to think merely on a purely factual level in music or perhaps they are simply not gifted with a musical intelligence. Often, they have a minimal interpersonal intelligence, and, therefore, cannot communicate well with their classmates or with an audience. Often they have little self-confidence in musical situations and are inhibited in front of a group (small or large).

An example is Mike, a fifth grader who has a marvelous math brain (Ah, how I envy that) which allowed him to add long columns of numbers when he was in the first grade. But MUSICAL ABILITY? Practically zero! His sense of pitch relationship is very poor. To listen to Mike sing a melody is a painful affair for the listener, but he loves to sing. Mike is physically uncoordinated and lacks a sense of rhythm. Yet, there he is ...GIFTED!

Erin, a V.T.S. student (a child taking part in the voluntary desegregation program) in the second grade, came to music class with no apparent interest in anything or anyone. She never smiled or looked at me or at her classmates, and did not participate in any class activity; but, in her little hand, she always clutched a magic marker. I noticed that after a few classes, Erin's eyes brightened when we sang patriotic songs. For her next class, I had a book opened at her seat with several pages of blank music paper marking the place of the "Star Spangled Banner". For a few classes she did nothing but methodically, silently copy from the music book while the rest of us sang or did other activities. Each day Erin asked for more paper and a different book. Soon she was copying songs on other than patriotic themes, and even began participating in class. Last week, Erin came to me, wreathed in smiles, and said, "I be in love with music." And she hugged me. Each day during my afternoon hall duty, Erin passes by with her music book, her music paper, magic marker, and a laughing, "Goodbye, Music Teacher." What an adorable, happy child she is.

Now, here's a story that has not been in my mind for years, but I believe that it has a definite place in this essay, for the musical intelligence which struggled to emerge in this individual changed her life; physically, mentally, and morally. It will take a little time to lay the background for the story, so bear with me.

This experience came back to my mind because of this damned bronchial infection which has me in bed right now. Yesterday, I was so sick that my doctor said, "Shirley, get to the office as soon as possible." (Of course, there was also the inevitable stop at the grocery store. Why is it that when one feels utterly dreadful, there are never soup, or soap, or orange juice, or tissues in the house?)

The weather was lovely, but a little chilly and very windy. Usually, I wear a heavy muffler (I'm always cold), but this particular day only a silk scarf was necessary so I opened a drawer and there was the exquisite scarf given to me at least fifteen years ago by Rachel Dieskau.

In the extremely wealthy Le Faire School District, there was in my elementary school a principal who allowed me the use of the music room for the purpose of giving piano and/or voice lessons to any parent who desired to study. There was no charge for these lessons; it was my way of making a contribution to society. Since the parents had seen the positive and supportive way that I work with children, a number of them signed up for lessons. Oh, I forgot to mention a point that is extremely relevant to this story. Within this wealthy school district, my school was the one which was literally, as well as figuratively, on the wrong side of the tracks. The families were of low income, at least, by Le Fair standards, and the population was about 95% Jewish. There was one family which was quite well-known among the faculty for they had three children in our school and seldom did a month go by that the father was not in the office complaining loudly about the poor quality of education that his children were receiving in this public school.

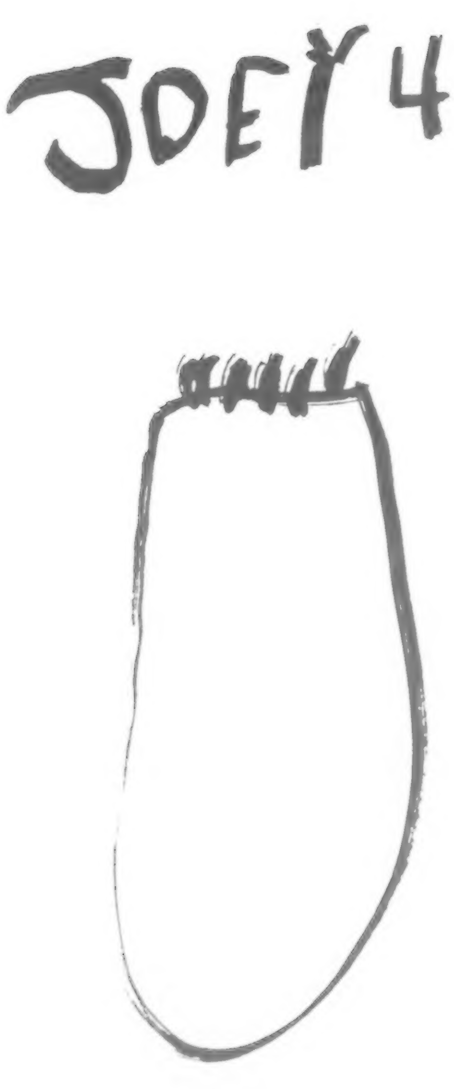
Certainly, he would have preferred to enroll them in the Hebrew Academy but there was no money. The mother was a little mouse of a woman, badly dressed, and completely intimidated and silent around this boorish husband. So you can imagine my surprise when, one morning, this dowdy, colorless Mrs. Dieskau appeared at the outside entrance to the music room. She said that she knew she could trust me even though I was a Catholic. (This fact became known throughout the school when my father died and the announcement of services was in the school paper.) She said that she had always wanted to study piano since her childhood but, of course, there was never money for her. Oh, yes, there was a piano in her home but it was only for the three daughters, and her husband would be very angry with her and with me if he should learn of her lessons. So we had a conspiracy. Rachel would enter the music room only from the outside door which was at the back of the school. I blocked the window of the hall door with a DO NOT DISTURB sign and locked the door from the inside. As you can imagine, Rachel practiced hours each day while the ogre was at work and the children were in school. Her progress from one lesson to another was astounding. As she gained in self-confidence in her music, I noticed that little by little she began to be much more neat in her appearance; there was a definite elegance and charm in her manner. After many months of devoted study, we had become very close friends and one day she began to tell me the story of her life.

She was a little girl, I think five years old, living in Nazi Germany, when one night, without warning, she was roughly taken away from her home and her parents, never to see them again for they were sent to Auschwitz and exterminated. Rachel was put into a Catholic home where her name was changed and she became Susan. She was brutally forced, for her own protection to renounce and denounce her heritage. She had come from an orthodox, religious family: the trauma was horrendous, and for years and years she was nothing more than a robot --- a Catholic robot. So you see, her fear and hatred of Catholics was deep, and that she put her trust in me was one of her giant steps back to mental health. Music became more and more important to Rachel and she was experiencing its healing force. One day she came to her lesson elated. For her husband's birthday, she had sat down at the piano and played for him. He was so thrilled, for he had seen her gradually changing from the dowdy, mouse-like creature into a lovely woman; and the husband, Rachel later told me, had become a much, much nicer person. It was after that birthday that both Mr. and Mrs. Dieskau came to the music room THROUGH THE HALL DOOR and presented me with that exquisite scarf. Ah, the power of music!

And now for my parting shot at intelligence tests. James Herndon and John Holt would love this story.

A few days ago, my brother-in-law called me and told me that he had met a fellow who had been in our class in high school. Henry was a likeable, outgoing kid -- a fabulous football player --- but dumb! We both took that same damned intelligence test and that let us know at an early age that we were, to put it delicately, not...very...smart. Naturally, Henry was tracked into shop. I said, "What's good ol' Henry doing now?" My brother-in-law laughed heartily and said, "Oh, you know Henry and me, we're just two aging, dumb ex-jocks trying to make a living. Henry makes about $300,000 a year. He owns his own construction firm. He specializes in BIG BUILDINGS --- like SCHOOLS." My brother-in-law, incidentally has his own business, too --- very big, and very successful.

P.S. It is probably against all the APA rules to end an essay with a P.S., but I know you will be interested in this information. I just spoke to our school counselor about Erin, and he gave me the cause of Erin's extreme unhappiness at the beginning of the year. A short time ago, she was raped by her father.



CONTOUR DRAWING AND DIMENSION

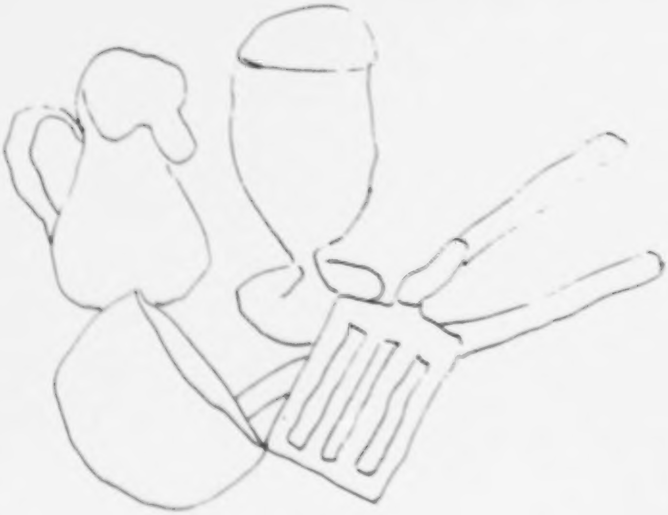
Julia Meyer

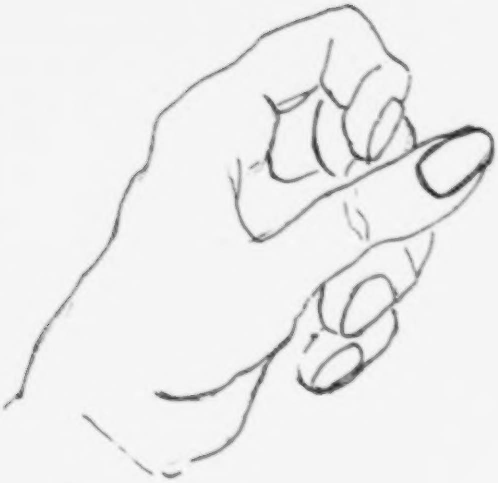
A contour drawing session is an interesting activity to accompany and reinforce a lesson on the concept of dimension. A single line drawn on paper has one dimension, length. A square drawn has two dimensions, length and height. A contour drawing has a three dimensional effect. The objects drawn appear to have volume. A contour drawing can be discussed in terms of three dimensions, length, height, and depth.

The materials needed for contour drawing are plain paper, pencils, and a few ordinary kitchen utensils. Salt shakers, pitchers, and egg beaters make good subjects. Hold up one of the objects and talk about what the line would look like if you drew around the outer edge of the major features. Notice how the line will curve, dipping in and out as it follows the contour. The objects should be carefully observed all the while they are being drawn. Salt shakers will look round as though they had room for salt inside. The illusion of depth, the third dimension, is apparent in all carefully drawn contour drawings.

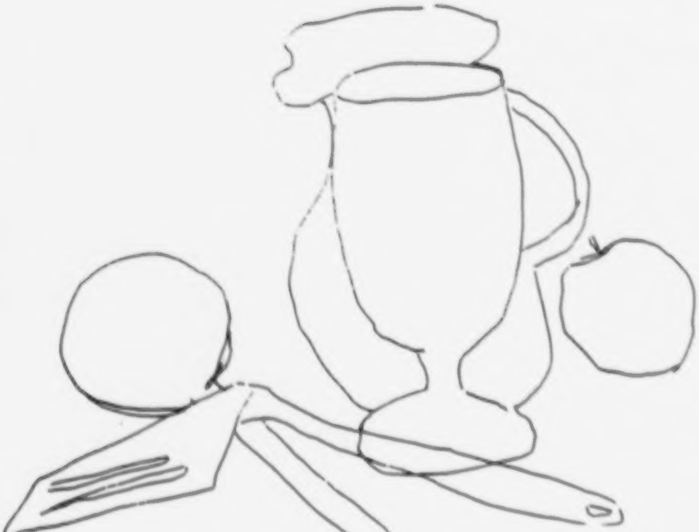
Although children's blocks are concrete examples of three dimensional objects, and invaluable as such in any learning situation involving dimension a teacher might devise, they represent a form not found in nature. Contour drawings of familiar objects extend the concept of dimension to all objects we see in nature and in our daily lives.

Third Grade Contour Drawing



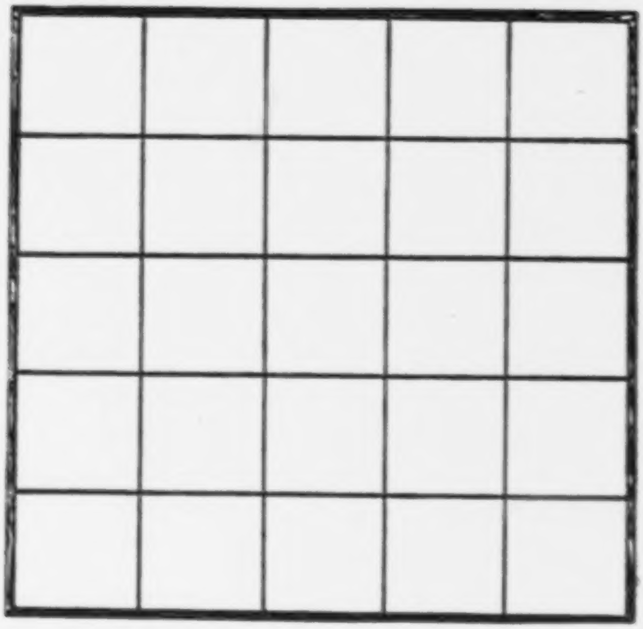


Third Grade Contour Drawing



SHAPELY PUZZLES

Susan L. Walker



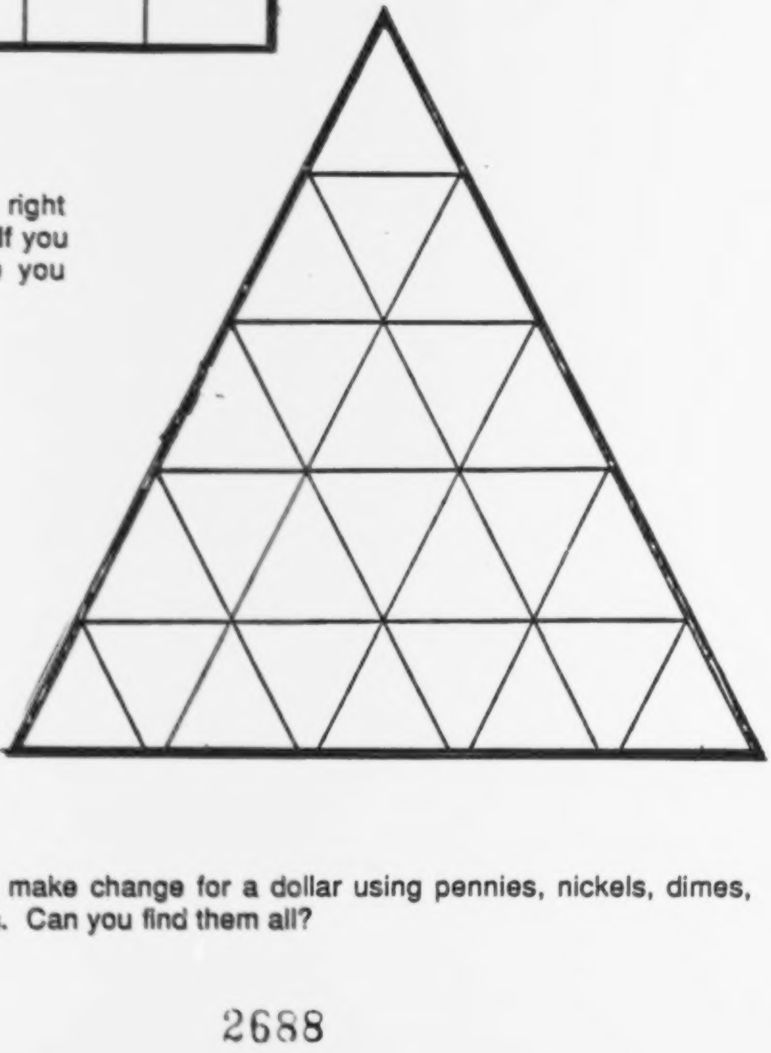
Squares Everywhere!

There are 55 squares in the diagram at the left. Can you find them all?

Good Luck

Try These Angles!

In the diagram to the right there are 48 triangles. If you can find them all then you know all the angles!



EXTRA!!!!!

There are 293 ways to make change for a dollar using pennies, nickels, dimes, quarters and half dollars. Can you find them all?

CHILDREN ARE CURIOUS BEINGS

Jolie Wells

Children are curious beings. They are continuously trying to find answers to questions. But once children enter the bureaucracy of the school system, their curiosity dies. In my opinion, our children's school years should be an active time. They should be encouraged to find answers to problems and to raise new ideas. Instead, our children are passive, just waiting for the information to be given to them. Unfortunately this is what our school systems have trained our children to do. If they don't adhere to the standards we have set, they are considered outcasts. Because they are looked upon in this manner, students are often rejected by their peers. I think the outcasts have a lot to teach to the "normal people".

Math should be a process of watching children as they construct answers instead of just looking for the right answer. By observing on my own, I realized that children don't think like adults. So why do we try to teach children adult procedures? Children really don't seem to understand the concepts they deal with in mathematics. Personally I don't blame them a bit for not understanding the concepts because they are adult oriented. Maybe instead of teaching math to children, children should reteach adults to do math.

There is so much mathematical information that I never used past high school. Why then do schools teach such unimportant material? If a child sees no importance in what he is learning, he will not retain the information. And considering all the time spent in preparation of this information, the teacher's efforts are wasted. Telling a student he must take particular courses in order to become a well rounded individual is useless. Learning information which is unimportant in the eyes of the child will only reflect how well the child can memorize. If this society wants well-rounded individuals, we should let the students help choose what they would like to learn about. By doing this, the students will probably learn a lot more than if it was force fed to them. In this manner, teachers can stimulate further interests in the students and guide them to the overall goal of learning.

By watching children solving problems, we can see not only if they answered correctly or incorrectly but why they answered the way they did. In our society today, adults are too quick to judge a person as wrong. They don't take the time to find out why a person is wrong. Maybe adults should look before they leap when judging a child. We should foster the growth of our children's curiosity and help them decide what is important instead of clogging their minds with trivia.

KOALA PAD AS AN ART MEDIUM

Glen R. Cornelison

After using the Koala Pad, I went home and thought, "How can I use this in my art room with the students?" Below is a group of lesson plans I have adapted to the Koala Pad.

Lesson 1
Masks

Using the free hand drawing pen, draw a mask or scary face. The secret of thi is exaggeration. Have students decide on an unusual shape for the face - very long, very wide, very heavy jawed, very wide foreheaded.

Somewhere near the middle, make two very large eyes (whatever shape they choose: pointy, round, square, oval). Be sure to put the pupil in the eyes. Now, continuing to exaggerate, make a nose and mouth, eyebrow, cheeks, shape for the chin, lines in forehead, hair either standing up or hanging down over forehead, possibly a moustache or beard. In some way, make all the features connect (by extending lines or running them together). Using the menu, pick up the fill and add color to your mask.

Lesson 2
Fancy Birds Imaginary and Real

Use pictures from World Book or any colorful source to observe the shapes of real birds. Then create a bird on the screen exaggerating the features. Make tail feathers longer, heads bigger and sharper, wings more decorative, topknots more elaborate. Add fanciful foliage or flowers to fill the screen. When the drawings are finished they can be filled in with color.

Lesson 3
Using Shapes on the Menu.

Circle Designs

Talk about different sizes of circles, ones that overlap and ones that hide behind each other. Some circles might even disappear off the side of the screen. Create a design in the circles using various types of lines. (see example)

Shapes Within Other Shapes

Divide the screen into various size squares and rectangles. After the space has been broken into smaller areas, discuss other shapes that might fit in these areas. Standard shapes such as circles, triangles, ovals may be used or the students may be encouraged to think of their own original shapes. Fill in with color. (see example)

Linear Design With Dots

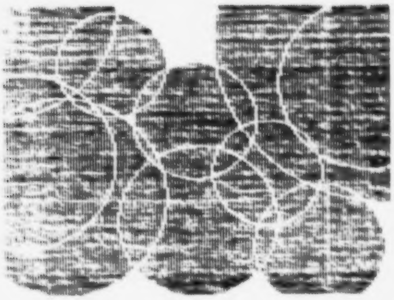
Place several circles on the screen. Beginning at either the top or the bottom of the screen and working vertically, draw lines that go around the dots in a linear fashion. Areas between the lines may then be filled in with colors. These can be warm colors; red, orange, yellow or cool colors; blue, purple, green. (see example)

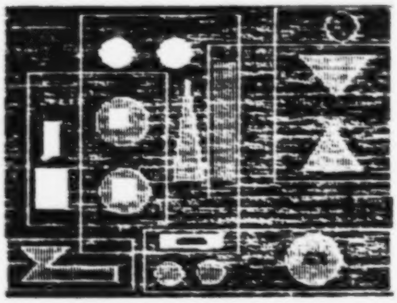
Lesson 4

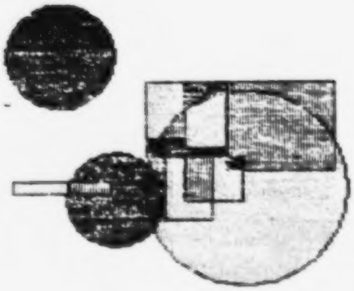
Using Set Shapes and Free Hand Draw Lines on the Menu.

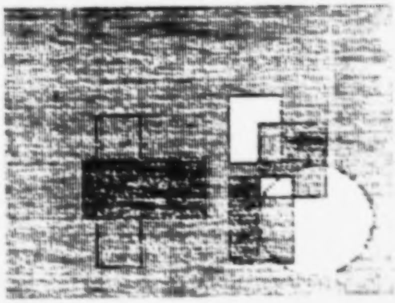
Imaginary Machines

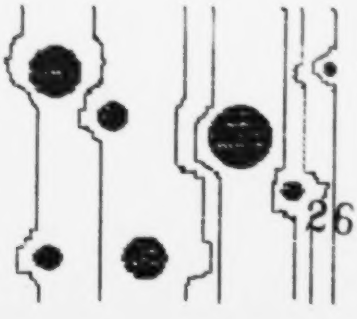
This design problem works in well with a unit on simple machines. Discuss the various parts of machines - cogs, gears, pulleys, whistles, springs, etc. to make parts of an imaginary clock or radio. Start by putting several small circles on the screen using the shapes off the menu. Then start building parts from there using the set lines off the menu or free hand drawing. These can be filled in with color or left black and white.











OBEDIENCE IS NOT ENOUGH

by Constance Kamii

Constance Kamii, Ph.D., recent visitor to SIUE, is professor of Early Childhood Education, University of Alabama in Birmingham, Alabama.

Some adults are responsible and have initiative. They have the initiative not only to notice what needs to be done, but also to go ahead and do it. Others have to be told everything and often forget what they promised to do.

Some adults have integrity. In the Watergate coverup affair, for example, Elliott Richardson refused to lie to the public when President Nixon told him to do so. The rest of the men on Nixon's cabinet obeyed their superior and went along with what they knew to be wrong.

Why do such differences exist among adults? One answer can be found in the theory of Jean Piaget. This theory helps us understand why children can be expected to become responsible and have integrity if adults interact with them in certain ways. Let us look at a few examples of interactions.

Different ways of interacting with children

When a child spills milk or paint, an adult can scold by saying, "I told you to be careful!" An adult can also say, "Would you like me to help you clean it up?" or "What do you have to do?" The important thing in this situation is that the child become more careful in the future. Being asked to restore the original condition is far more conducive to being careful the next time than a scolding. The child who spilled something already feels bad about what has been done. Being scolded makes children resentful rather than more thoughtful.

Similarly, when children break, damage, or take something that belongs to somebody else, asking them to repair, replace, or return the object is much more conducive to thoughtfulness in the long run than a scolding or punishment. One day, in a kindergarten class, for example, a child came up to the teacher and was crying because his art project had been damaged. The teacher turned to the class and said that she wanted the person who broke the object to tell her privately so that she could help him repair the object. The child responsible for the breakage was helped to see the point of view of the victim, and was encouraged to make for himself the rule of reparation. When children are not afraid of being punished, they are willing to come forward and make restitution. The teacher helped him repair the broken object and told him that next time something similar happened, she wanted him to tell her so that she could help him fix the object again.

Many parents and teachers believe that the way to raise children to be moral is by punishing "bad" behaviors and rewarding "good" ones. Reward and punishment may be effective in the short run, but not in the long run. Punishment leads to three possible outcomes. The most common one is calculation of risks. The child who is punished will repeat the same act but try to avoid being caught the next time. Sometimes, the child stoically decides ahead of time that even if caught, the price will be worth paying for the pleasure. The second possible outcome of punishment is the opposite of the first one, blind conformity. Some complain children become perfect conformists because conformity assures them of security and respectability. When they become complete conformists, children do not have to make decisions any more, as all they have to do is obey. The third possible outcome is revolt. Some children are angels for years but decide at a certain point that they are tired of pleasing their parents and teachers all the time, and that the time has come for them to begin living for themselves. They may, thus, even begin to engage in various acts of delinquency.

While rewards are more pleasant than punishments, they too discourage children from judging for themselves what is right or wrong. Children who help parents only to get an allowance, or those who keep a promise only to get candy are governed by others, just like children who are "good" only to avoid being punished. Adults exercise power over children by using rewards and punishments, and it is these that keep them obedient and dependent on others to know what to do.

It is true that adults are influenced by rewards and punishments. But when we are influenced more by the reward system than by personal conviction about what is right, we get phenomena like the Watergate affair. The great majority of people in the Watergate affair obeyed their superior, who controlled them with rewards and punishments. A more recent example is Klaus Barbie, who disclaimed any responsibility for the murder of so many Jews by saying that he was only carrying out orders.

Two kinds of morality

The Watergate affair illustrates the difference between the two kinds of morality distinguished by Piaget: the morality of autonomy and the morality of obedience. Autonomy means being governed by oneself. An example of the morality of autonomy is Elliott Richardson. As I said earlier, he was one of the few people under Nixon who refused to obey his superior and resigned from his position. The others are examples of the morality of obedience.

When children tell a lie, adults can punish them by saying, "You will not have any dessert tonight" or "You will have to write, I will not lie' 50 times." The adult could also refrain from punishing and, instead, look the child straight in the eye with great skepticism and affection and say, "I really can't believe want you are saying because ...(and give the facts that render the statement hard to believe)." The adult can also say that a relationship of trust is broken when a person says something that is not true. This is an example of an exchange of points of view that contributes to the development of autonomy in children. Children who can see that adults cannot believe or trust them can be motivated to think about the necessity of telling the truth. Children who are raised with many similar opportunities can, over time, come to the conclusion from themselves that it is best in the long run for people to deal honestly with each other. As an adult faced with a superior like Mr. Nixon, this person is likely to insist on being honest because of a personal conviction about the value of honesty.

The importance of exchanging viewpoints with children and letting them make decisions

The most important elements for children's development of autonomy are opportunities to exchange viewpoints with other people and the possibility of making decisions. The morality of autonomy is based on an individual's personal values, rather than the reward system. This means that children need many opportunities to construct personal values for themselves, and this is why the above two elements are essential.

As we saw in the example of children's lies, they can feel the value of being honest only if they have had many opportunities to see for themselves that people could not believe or trust them when they told lies.

Children learn to make wise decisions not by being obedient, but by making choices and decisions for themselves. The decisions they make are often unwise and this is the hardest part for parents and teachers to watch.

Making decisions is important for children for two reasons. First, children cannot find out about the wisdom of one decision if they do not have opportunities to compare its consequence with the consequence of a bad decision. By deciding to wear new patent-leather shoes to school, for example, they can learn the wisdom of wearing tennis shoes that allow them to run freely and to climb on the Jungle Gym.

Second, children can become responsible only when they are truly responsible for the decisions they make. As long as decisions are made by somebody else, children are not responsible for them because all they have to do is obey.

Young children can make only small decisions at first, and gradually become able to make bigger ones. For example, making a schedule for the entire day in school is out of the question for young children, but choosing an activity during free play time and voting on a rule at clean-up time are perfectly manageable decisions for four-year-olds.

Certain decisions are not open to discussions. Naptime and bedtime are examples of decisions that are made by adults. The important thing is that children be allowed as much as possible to make decisions for themselves. Even bedtime can be made more acceptable to children by letting them know well in advance that after dinner, a television program, and a story, it will be time for bed.

Why start so early?

Many people believe that autonomy is for adults, and that what is appropriate for young children is obedience. But good judgment does not develop all of a sudden when the child is 16, 18, or 21 years old.

By age five, children already vary a great deal in their ability to make decisions for themselves. Some five-year-olds run to adults to say, "Johnny hit me," and expect adults to solve very problem of this kind. Others tell their teachers and parents to stay out of their conflicts because, "It is up to us to settle things between the two of us."

When the teacher leaves the room, some groups immediately explode in chaos. Others go on as if the teacher had never left the room. If children are used to making decisions for the good of the entire group, they can govern themselves without being controlled by an adult.

Some five-year-olds even have the initiative to say to the entire class, "There is a problem here that we have to discuss." A teacher who believes in fostering the development of autonomy reacts by saying, "What do you think we should do?" and "Does everybody agree that that is a good idea?"

The autonomy of five-year-olds does not happen by chance. It is the result of exchanging viewpoints with other children and adults day in and day out, and of being allowed to make decisions. The more autonomous children become, the greater the possibility for them to become even more autonomous. This is why it is important to start fostering autonomy early in life. Five-year-olds who can already govern themselves with respect to small decisions are more likely to become more autonomous in dealing with bigger issues.

Intellectual development

Exchange of viewpoints and negotiations are important not only for children's moral development, but also for their intellectual development. For example, being told that another person cannot believe a lie motivates the child to reconsider the situation from the adult's perspective. This kind of coordination of viewpoints is essential for children's development of logic. I still remember wondering, with all the intellectual power I had as a child, how my mother could possibly know that I was lying!

Adults often repeatedly tell children to be quiet at the dinner table and in waiting rooms. This command is good neither for their moral development nor for their intellectual development. It is much better to negotiate a solution with them by asking what they think they can do to occupy themselves. They may think of going to another room, looking for a book, or drawing a picture. This negotiation requires inventiveness, if-then relationships, and the coordination of points of view. Children who thus negotiate mutually acceptable solutions day after day develop their ability to think logically because they have to make sense to others if they are to be convincing. This ability to think logically is an important foundation for learning to read, to do arithmetic, and to organize every other kind of knowledge in and out of school.

The principles discussed above may require more patience than you think you have. But if we want children to become able to act with personal conviction about what is right, independently of the reward system, we must reduce our adult power and avoid the use of rewards and punishments as much as possible. We must, instead, exchange points of view with children, negotiate solutions, and let them make decisions for themselves. Only then can they build for themselves their own personal feelings of necessity about what is fair and right for everybody concerned.

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MAD MINUTE

Mary Skaer

"Ready? Go!" This is one statement I hear every day as Math begins in the classroom. After a minute passes, the teacher says, "Stop!"

This is a daily occurrence in the fourth grade room. What is going on for that minute? I'll tell you: anxiety, frustration, aggravation, and despair! Mad minute is the perfect name for this activity. I get angry every time I see a child rush through his paper like a mad dog.

"Mad minute" is an activity in which each child is given one minute to finish fifty problems. Each day they advance to a harder and longer sheet, and every day they hear "Ready? Go!"

As she states those two words, I hear papers ruffle, and hands rapidly moving across the page. Each day the teacher or I grade them. The children receive one point for each correct answer, that is, until they answer one wrong. At the first wrong answer, we stop grading and go on to the next page. This is crazy but true.

My objections to this activity are many. First of all, the children are being pressured. Who is able to do their best work under extreme pressure. One minute? If you could see the children during this activity you would see my point.

My second objection is that the papers become harder each day. The times tables become larger, and the number of problems increase. The students who were lost two weeks ago, are now under water. I see those children just sit there, for they know they cannot finish time tables in one minute. Neither can I. For those who feel "stupid," or are slow when it comes to math, it only reinforces their feelings of anxiety and hate for math.

If someone gave me fifty calculus problems, I would not even attempt to start them. This is the way quite a few of the children feel. Why attempt it, I know I can never finish it?

Every day, their points are added to their graph for everyone to see. As for Jake, who is having problems with math, his graph is very small compared to Chris who has over 120 points already this month.

My logic involves at least talking to them about their mistakes when they get their papers back. If you discuss the problems they are having, they can usually be corrected. "Tommy, I see you missed this problem. Please tell me how you worked this problem." If we know how they worked the problem, we can usually find the root of the problem.

Many of the children did not realize they could solve the harder problems by relating it to something they did know. They had very little exposure, if any, to this notion, and "math" is just brute-force memory.

"Mad Minute" is not worth all the frustration and pressure it places on children. It hurts those who need to build their self confidence, and shows to others that Jake is not very good in Math. Jake, though, needs all of the confidence building therapy he can get. I would never use "Mad Minute". Every time I hear "Set Go," I want to cry!

DICE!

Michelle West

During my field work at SIUE for my undergraduate degree, I tutored math students in a second grade classroom. I never realized the extreme difficulty children encountered when it came to borrowing or regrouping. It seemed as if some children can go for weeks without showing any signs of comprehension in this area, all the while the kids were getting further discouraged and frustrated and disinterested.

An excellent beginning activity I used that might help other slow learners uses dice to help show the concept of borrowing or "regrouping." Children can start with 2 dice, but will have to add dice to get numbers higher than 12. The activity goes as follows:

Have the kids throw dice (start with 2) and have them record their numbers as an equation. Many children can add 5 + 6 on dice, but don't see the correlation to $\begin{array}{r}5\\ \underline{+6}\end{array}$. Keep adding dice and have the kids record their work on paper. This will serve as a stimulating activity and a less frustrating situation. As the kids get better and start to understand a little more, increase the number of dice. For example, if you are using 4 dice and the following numbers are thrown, have the kids record in this format (in any order) to help them regroup:

$$\begin{array}{r}4\\ \underline{+5}\\ 9\end{array}\qquad\begin{array}{r}9\\ \underline{+6}\\ 15\end{array}\qquad\begin{array}{r}15\\ \underline{+6}\\ 21\end{array}$$

The kids will then be able to see the process they have used to get the answer and will also be impressed that they have worked their way up from using only 2 dice.

Obviously, this can only be used as a beginning activity, but will serve as an inspiration for those who believe there is no hope at all!

WHAT ARE WE PREPARING THEM FOR?

Christina Stamps

One function of American schools is to prepare youth for the world of work and other adult roles. If some schooling has been considered good for this, more schooling has been thought to be even better. Let's take a look at the educational environment where this preparation takes place. Most often, it is an environment that is individualistic, oriented toward cognitive achievement, imposing dependency on and withholding authority and responsibility from those in the role of students.

So what then is the student prepared for? As a student, he is forced to accept his loss of autonomy and initiative to a teacher who acts as a superior authority, dispensing rewards and penalties. As a worker, he is prepared to relinquish control over his activities on the job to a boss who finds it necessary to motivate him through rewards that are external to the work itself, such as money and prestige.

What is wrong with our schools is reflected in the adult roles we are preparing the young to undertake. But, the adult roles have changed. There has been a dramatic change in the world of work due in part to the rapid development of science and technology, i.e. computers. In l982 about one million computers and data terminals joined the four million already in use in the offices in the United States. The number has been increasing by some 25 percent each year and will continue to do so for the next decade. The computer revolution is changing the very texture of work. More than ever, jobs are becoming head work--mental, abstract, and demanding concentration. The shift to mental work is true even in factories.

There is a need to produce autonomous citizens who can think for themselves in all kinds of situations. In order for youth to be able to cope with the rapidly changing adult roles, the school must move forward to an educational system in which the children are intrinsically motivated to learn, to think, and to be able to make decisions on their own. This educational system is one in which autonomy is the long-range goal. This goal is directed toward learning how to learn and toward continuing this development beyond the classroom, throughout life.

4

shane

COMPUTER KIDS

Linda Kumke

In my worst nightmares, I imagine walking into my classroom - my first day on my own - and seeing a classroom full of mechanical children. They all have human parts except their heads. Their heads are computers with keyboards to type in information. When they walk, they move like you'd expect a robot to move.

At the front of the room, on my desk, there's a master terminal and keyboard for my class. Whatever I punch in goes directly to each "student". Sometimes their screens come up saying "DOES NOT COMPUTE". Then we skip to another channel and try it there.

My dream (or, nightmare) ends with all my children short-circuiting, sparks flying, computer kids running into each other and falling all over. With nothing for me to do, I run out of my classroom and then I wake up. Funny, I've never found out what lies beyond my computer kids in my computer classroom. I'm not sure I really want to find out!!!

I think what brings on this nightmare is my fear of computers and of what some teachers do to children when they treat them like computers. I think teachers expect kids to be computer kids who can accept any and all information and immediately spit it back out at the press of a single button.

Granted, it would be nice if teaching were as easy as having a master terminal and computer kids who accept all information. The problem is, not all channels work in every child and teachers need to fumble around to find an accepting one. But, who wants to spend all that time? If the student doesn't pick up the information after the first couple of channel tries, teachers give up, and go on to something new.

Children are too fragile to be treated like that. They don't come equipped with a scanning device that allows you to search for an open, accepting terminal. It's something that needs to be done with tender care. Something that may give a teacher headache on top of headache and may take a very long time to accomplish. In fact, it may be the teacher who short-circuits and malfunctions.

But, in the end, all the hard work will be worth it because you will have gotten through to an otherwise unresponsive child. The child will beam with happiness and you will feel fulfilled - and relieved.

CUTTINGS

Teachers who come to the Teachers' Center turn in a weekly diary. In it they've written about what they've been reading, activities they've tried with kids and their observations of children's thinking along with general comments they wish to make about what they've been thinking, reading, doing and observing.

Many of these diaries contain material that is too good to remain buried in someone's file; it begs to be shared. So, in "Cuttings" we've simply lifted parts of individual diaries and reprinted them. Read them, think about them, share them and help them grow.

What comes after 983? "984." "Can you keep going?" "984, 985, 986, 987, (pause), 988, (pause), 189, stop. "You said 988. What comes after that?" "989." "What comes after that?" "200."

Count by 2's for me. "2, 4, 6, 8, (skipped 10), 12, 14, (hesitate), 16, 18, 20, 22." Can you count by 2's, starting at 7? "Nope. You can only get 8, 10." What if you just added 2 every time? "7, hesitate, it'd be 9. Its an odd number." What comes after 9? "11. It's an odd."

Can you count by 10? "10, 20," continuing to 100. Can you count by 5's? He counted easily from 5 to 100. Start with 8 and count by 10. "You can't. You skip it." What comes next? "29, 39." What comes next? He counts on his fingers, "49? They always have 9's at the end!" So what comes next?" "59." What comes next? "69, 79, 89."

Marty, 5, in kindergarten

After he counted out 5 pennies, I covered 2. He wiggled his fingers, and said "2." He showed me 3 fingers up and 2 down. He said 3 up and 2 were left. I covered 1, and he said 1. How did you know? Shrug. I covered 4. He used his fingers again, 4 down, 1 up. With 3 pennies covered, he had 3 down, leaving 2 up.

With 7 pennies, I covered 4. He started with five fingers and got stalled. Then he stuck up 2 fingers on the other hand. It seems like he put down enough fingers to leave 3 up. I covered 5 pennies. This time he put up 7 fingers immediately. He bent down 5, to leave 2. He seemed to check the 2, count 5 fingers, and said 5. When I covered 7, he grinned, and said "7."

He counted out 9 pennies. The first time he showed me 8. When I asked him to count them again, he corrected himself. I covered 4 pennies. Immediately he worked with 9 fingers, 5 down, and 4 up. He said 5. I covered 2. By now he was starting to lose interest, and play with a broken ruler that was on the table. I talked him through his fingers up and down method.

I would like to have tried him with 11 pennies, to see if he could adapt his method to a total over ten, but I felt I was losing him fast and he had already done his best work.

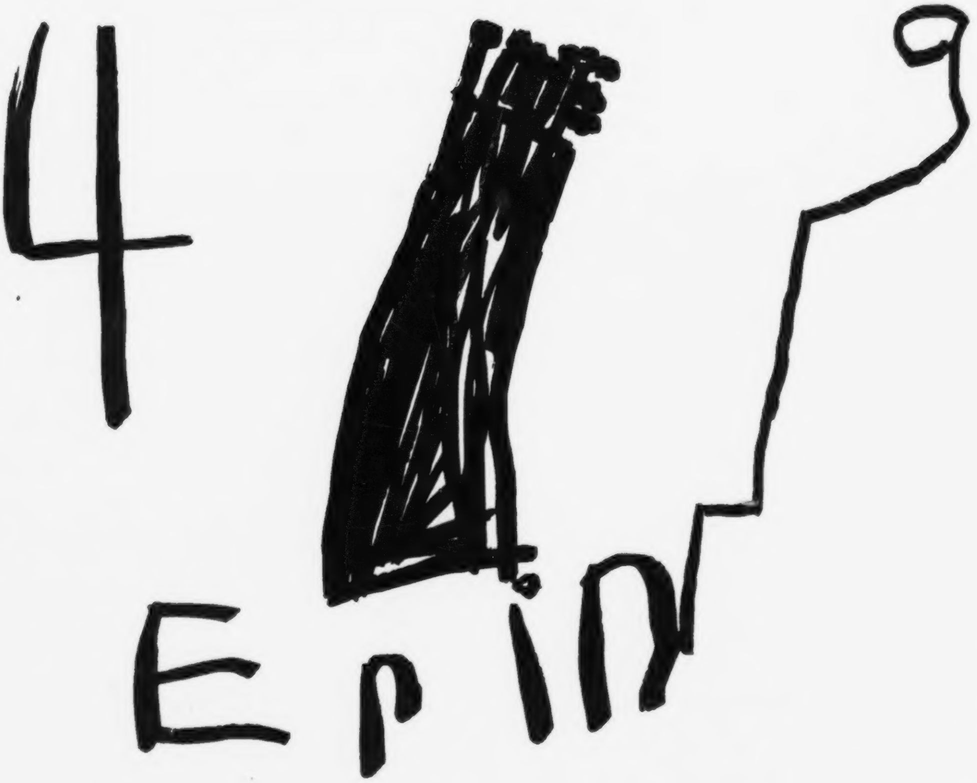
Count for me. He counted from 1 to 28 and hesitated. What comes after 28? Shakes his head.

COMMENTS:

Jennifer, the 4-year-old seemed to have a good understanding of the number 5 and the combinations that add up to 5. She was confused when I covered none; apparently in her mind there had to be at least 1 penny under my hand. With 7 pennies, she seemed to make wild guesses at first, but on the 3rd try, discovered a method. I think that the numbers she was saying did not exactly reflect what she was doing mentally, but she did have a method.

Jay came rather quickly to the counting on method. With counting by 2's and 10's he at first thought it was only possible with multiples of 2 and 10, but soon saw the pattern of adding by 10.

Marty had a finger method which served him well on 5's and 7's. I do not know exactly what caused him to lose interest on 9's. Some possibilities are a discomfort with the bigger numbers or possibly a short attention span, shortened even more by interesting things going on in the next room.



CUTTINGS
Michaeline Wasson

CHILDREN'S ARITHMETIC: HOW THEY LEARN IT AND HOW YOU TEACH IT
by Herbert Ginsburg

Chapter I "Learning to Count"

This chapter suggests that numbers are not so mysterious after all. They are a song to sing in which you must remember not only the words but also their right order. Once the song is learned, children are asked to sing it in some strange ways: skip every other word, sing it backwards, and so on. We can ourselves get some appreciation for the difficulty this causes young children by performing a little experiment on our knowledge of "Jack and Jill". Example: What word comes before down? What word comes after his? Say only every third word. Say the whole verse backward. This task is quite hard, and it is the same kind of task children have to do with "one, two, three..."

There is no rational basis for predicting what comes after a certain number. Children have to memorize the smaller numbers in a rote fashion. After a period of time, they discover that the numbers after about I3 contain an underlying pattern. Using it, children develop a few simple rules by which to generate the numbers up to about I00. When the pattern is there to be found, they exploit it. Children do not learn in only one way! (And, oh how true this is!)

Chapter 2 "Concepts in Babies and Little Children"

In our daily lives, we are continually faced with problems of quantity. Consider how thoroughly quantity fills the world of infants. They lie in cribs with a certain number of bars. The walls in their rooms displays repetition of bricks or wooden boards or regularity in the pattern of the wallpaper. Their parents go into the room and out of it over and over again. Some of their toys are bigger, identical and equivalent in size. Infants thus have ample opportunity to learn about number, repetition, regularity, differences in magnitude, equivalence, causality and correlation.

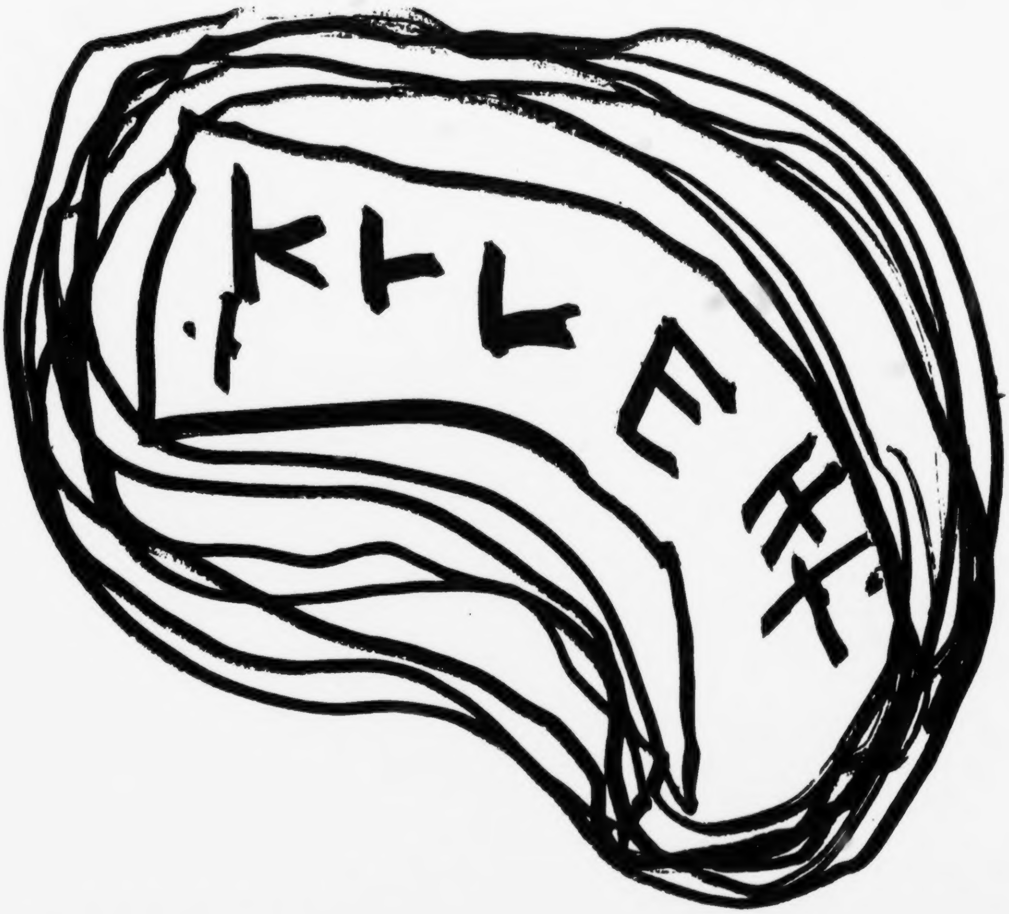
Quantitative concepts continue to develop from age two to six. During this time, the child has notions of "more" and "less", "same", and "adding". Children's concepts and
skills are implicitly informal, and nonverbal: they cannot talk mathematics explicitly. It is intuitive.

Chapter 4 "Helping Young Children"

In this chapter, he offers suggestions on how to help young children to learn elements of arithmetic. These suggestions are:

I. Keep a proper balance between teaching and the fostering of spontaneous growth.
2. Get acquainted with children's intellectual life.
3. Make available to children a stimulating environment.

4. Trust and support children's intellectual work.
5. Give special support to children's counting.
6. Don't try to teach little children the new math.
7. Avoid formal training, especially verbal instruction.
8. Don't bother with readiness activities.
9. Don't waste time on the training of conversation.
10. Keep in mind preschool children's tremendous accomplishments.



CUTTINGS
Aggie Raine

My first encounter with the ideas of Howard Gardner was in an article which appeared in Readers Digest, May 1985. I read the interesting article with enthusiasm. It wasn't until I finished that something clicked in my head. This was the same Howard Gardner you had suggested I read earlier. I've tried desperately to keep up with all your suggested readings but still have a long list of books I need to attend to. This article was a condensed version but the ideas Gardner proposes about the different areas parents and teachers need to look at in children were enough to give me a feeling for what Gardner sees as important.

As I read the article, the pieces fell into place for me. I had mentioned before that all three of my children were different. I can see now that each of my daughters are gifted, but in different areas. Now that I understand the seven kinds of smart I will be able to respond and feed the fires. As I teach children I will remember these seven areas of giftedness and encourage enrichment. Gardner points out that I.Q. tests only focus on linguistic and logical-mathematical intelligences, but the other five also deserve attention. I liked his explanation of what school and life is all about. "Kids make their mark in life by doing what they can do, not what they can't," and "School is important, but life is more important. Being happy is using your skills productively, no matter what they are." This is another whole area that is being overlooked in schools today.

"The Genetic Epistemologist"
"Forward to Basics" by Tom O'Brien

The History of education was interesting to know. A lot was said in such a short piece. The statement "What children experience in school....curriculum.....is often an exercise in disarticulation" really made me think. This is what is going on in schools isn't it? It's no wonder children have difficulty sitting still and keeping "minds on". When I listen to the teacher, I have difficulty understanding what she is talking about, so I can imagine how the kids feel. "The development of effective communication and the sharing of knowledge from person to person" is one of the biggest changes we need to see in education. I'm all for more group work...working together toward a common goal. We could throw all competitive tasks out the window. I see way too much of this going on. The kids are never given the opportunity to have their voices heard, except to answer questions for the teacher, which are usually answers to workbook pages. It makes a difference if you listen to what kids have to say.

This article brings to mind a science lesson I taught several weeks ago. Actually, I incorporated science, writing, English, art, sequencing, reading, and observation. This is how it went.

(I) Each child was given a plastic ziploc bag into which a wet paper towel was laid. Twelve seeds were added--3 each of corn, pea, bean and radish. I made up a control "A" and a control "B" bag. Bag "A" had no wet paper towel and Bag "B" was just like the kids except it was taped to the outside of the window. I asked them inference questions I wanted them to think about. One week later we got together again as a group.

(2) The kids were excited when I took the bags down from the line--they were hung up by clothespins. The seeds had all sprouted and were growing nice long roots.

(3) The kids sat on the floor as we discussed what we had learned. Everyone had their eyes on me. They were so excited about their own seeds as they compared them with their neighbor. After the kids discovered on their own what I had hoped they would learn and discovered some things I hadn't thought about, they returned to their seats.

(4) Each child took their seeds out of the bag and drew the seeds and their roots. They labeled each of the different seeds. The drawings were beautiful and very detailed. (What surprised me most about the lesson was the kids attachment to the seeds--they acted as if they had just given birth, carefully handling the seeds and being possessive of them.)

(5) Next, the kids grouped together on the floor in front of the blackboard. Working together they told me the steps we had taken to make the seed sprout. I wrote the steps exactly as the class decided they should go. After the steps were completed, I read them and asked the children if they had any changes they wanted to make. The kids then read them together as a class. They gave the activity a title and returned to their seats. Each child wrote the steps onto a piece of writing paper.

(6) We assembled the work in book form and the kids made drawings on the cover.

(7) The end product was lovely! We used construction paper for the front and the back. And stapled the pages together.

(8) Next we planted the seeds in styrofoam cups and potting soil so they could take them home.

The amazing thing about this activity was the lack of behavior problems. All the students were engrossed in the activity right from the start. I just guided them through the steps. The kids' results were wonderful!

CUTTINGS
Joyce Bishop

This week I asked seven children the question "Why does it get dark at night?"

Jeremy, 4, will start kindergarten in the fall
"I don't know."
Interviewer: "Do you know what happens to the sun at night?"
Jeremy: "I don't know."

Marty, 5, first grade next year
Big grin, "I don't know."
(much later) "Because the sun goes down."

Teresa, 7, second grade next year
"You already asked me that question: Why does it get dark at night? You said "Where does the sun go?"
I: "Why DOES it get dark at night?"
"Because the sun goes down and the sun goes to the other side of the world and it's turning to afternoon. The world is turning real slowly and its going to get dark here and the other side of the world is getting light."

Nathan, 7, third grade next year
"Cause the earth turns. . . . and the sun and the moon are on different sides. One half of the earth is day the other's night."

Jay, 7, third grade next year
"Because on the other side of the earth it will be hot, I mean daytime, and on our side it will be night."

Kit, 9, fourth grade next year
"Cause the world turns and the other side of the earth gets the sun."

Dena, 11
"Cause God has to go to sleep, I mean, he has to wake up."

Another opportunity for childwatching presented itself this week, and I didn't pass it up. There were two fairly bright fourth grade girls in my Sunday School class the day the Bible story mentioned that it took Ezra only four months to travel the 900 miles home to Judah from Babylon. I took the opportunity to see if the girls could find out how many miles Ezra's party would have to average per day.

The first step was to see how many days there are in four months. Jennifer figured it in her head and said 120. The other worked a long time with paper land pencil and got 1200. After comparing answers, Lisa said "Oh, I multiplied by 40."

They were sure that the next step was division. Lisa pointed out that 900 went inside the division bracket. After some feverish figuring, Lisa said "875." I didn't give an affirmative answer, so they went back to figuring.

I started to talk them through an estimated answer, but they didn't stop and listen to me until I put a hand on each of their writing arms. Then we rounded 128 to 100, and reasoned that the answer must be somewhere in the neighborhood of 9. Also, it would be less than 9 because 120 would not go into 900 as many times as 100 would.

This time they came up with 7 remainder 60, which they agreed was half of 120. About this time, we realized that the Jews probably would not have traveled on the Sabbath, and that 7 1/2 Sabbath miles would have to be figured into the other 6 days of the week, but I chose not to take any more Sunday School time to tackle that question.

I was concerned with Lisa's inability to figure a problem like 4 x 30 in her head, and her inability to recognize an unreasonable answer. I think she is probably pretty good at doing problems according to a set procedure, but I question whether she understands what she is doing enough to apply her math to a new situation.

CUTTINGS

L. Hoeke

Through my experiences these past few weeks I have begun to realize how desperately education needs to change. I never realized what happens to most children as they go through our present educational system. As children enter school they are excited by and intensely involved in learning. The more contact children have with our present system the less excited and involved they become. My readings in Labinowicz's "Piaget Primer" made me aware of this. Labinowicz frequently speaks of watching children's faces as they participate in activities. So, I started to watch their faces. I saw frustration, boredom, apathy, very limited involvement, and vacancy. Only rarely, was there excitement, true discovery, wonder, and the look that comes with accomplishment. The children seem to look at learning as a passive activity -- the morning bell rings and the teacher turns on, like the TV. At the last bell the teacher turns off and they can go play.

CUTTINGS
Cheryl Smith

I compiled this list from other lists I had seen plus Andy White's list reprinted below. This list of 20 seems to be the areas that are most important in my use of software. Most of the good software I have seen would excel in all of these areas.

SOFTWARE CRITERIA - My own list -

1. Does the program fulfill worthwhile purpose?
2. Does the software appropriately reinforce skills
3. Is the material meaningful, challenging, motivational, and visually interesting?
4. Are there simple clear directions, clearly stated activities, and encouraging responses?
5. Are clear objectives provided with the software?
6. Is it adaptable to various ages or group sizes?
7. Can it be used with a minimum time for teacher preparation and teacher assistance?
8. Does it encourage student interaction?
9. Are various levels of difficulty provided?
10. Is it free of bugs?
11. Is it accurate?
12. Does it guide your use of the keyboard?
13. Does it stretch the user's thinking?
14. Can you "get out" of the program?
15. Are graphics, color, and sound used for appropriate instructional reasons?
16. Is there effective feedback?
17. Is it more than pure "dull"?
18. Are useful supplementary materials provided?
19. Is the content free of racial, ethnic, and sex-related stereotypes?
20. Is it reliable?

ANDY WHITE'S LIST
COMPUTER SOFTWARE EVALUATION CONSIDERATIONS

1. Does the program fulfill its purpose?
2. Is the software appropriate for the situation in which it will be used?
3. Is the software suitable for the intended users?
4. Does the software adapt the computer to the user or must the user adapt to the computer?
5. Does the software take advantage of the capabilities of the computer in presenting the lessons?
6. Is the program adaptable to different children and teaching methods?
7. Will the program hold the user's attention?
8. Does the software provided useful feedback to the user?
9. Content of the program

- a. the content is accurate.
- b. the content has educational value.
- c. the content is free of racial, ethnic, sexual, and other stereotypes

10. Instructional quality
    - a. the purpose of the package is well-defined.
    - b. the package achieves its defined purpose.
    - c. presentation of content is clear and logical.
    - d. the level of difficulty is appropriate for the target audience.
    - e. graphics/color/sound are used for appropriate instructional reasons.
    - f. the package is motivational.
    - g. the package effectively stimulates student creativity.
    - h. feedback on student responses is effectively employed.
    - i. the learner controls the rate and sequence of presentation and review.
    - j. instruction is integrated with previous student experience.
    - k. learning is generalizable to an appropriate range of situations.
11. Technical quality
    - a. the user support materials are comprehensive.
    - b. the user support materials are effective.
    - c. information displays are effective.
    - d. intended users can easily and independently operate the program.
    - e. teachers can easily employ the package.
    - f. the program appropriately uses relevant computer capabilities.
    - g. the program is reliable in normal use.

Brad 4

CUTTINGS

Kathy Nau

On Egocentrism

I talked to three-year old Luke, the son of some good friends of mine. I asked him if he had any friends. He said yes. Mommy, Daddy, Tina, Troy, and you. I then asked him if he was a friend to anyone. He said no. I was shocked! I had no idea that anyone would think like that. During our conversation, it occurred to me that he is a very bright little boy. He can count to twenty and he can spell his name but he has no idea that he is a friend to someone.

I also talked to a four-year old, Nikki, on the phone a couple days ago. She asked me to guess who was coming home to her house. There was not one who came to my mind, but she insisted on making me guess. I said some names and they were all wrong. She said a list of names that I did not know. She had no idea that I did not know them. Neat!

CUTTINGS

Aggie Raine

I agree that what is going on in many schools today is not good. At a school I observed, I saw many problems with the teachers and the students. I was very disillusioned at this point. How could I ever teach these kids the way I think a teacher should? For some reason I thought these kids were different. It seemed like the whole school was in trouble. Well, I finally touched base with these kids after three weeks of working diligently with them. These kids are no different than any other kids except they have been abused by teachers and adults. They had so many behavior problems, I just didn't think I could work beyond that - but I did.

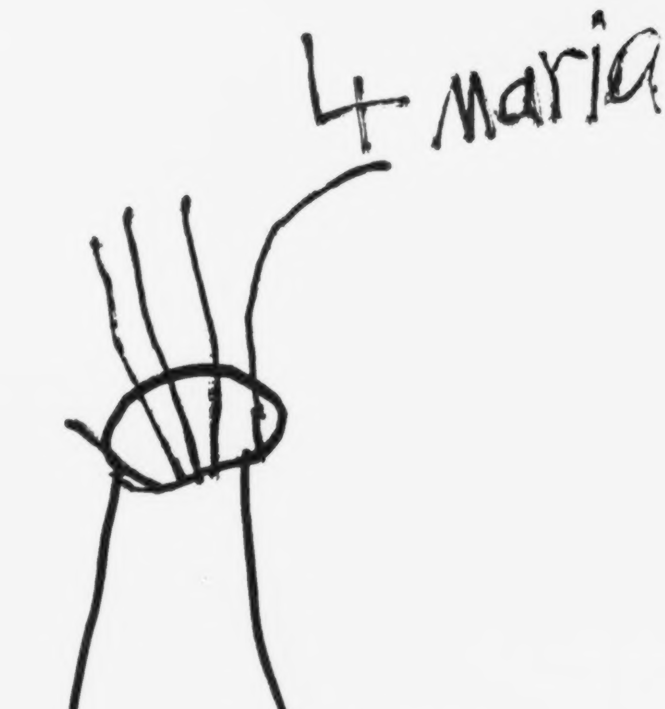
This is how it happened. After watching the children in reading class, I realized they were getting so bored they became restless. Since the library had so few books and the classroom library was even worse, I decided to bring my library to the students. Whenever my reading group finished the required work, we had "quiet reading" time. The children each chose a book and found their own little corner. They were so excited!!! I can't tell you how good I felt when they all got into reading. It's the first time I saw them excited about reading class. Guess what? No behavior problems! As the children returned the books, I would ask, "Steven, how did you like the book?" That's all I needed to say, because Steven took over from there. As I showed excitement, Steven showed even more excitement! I don't have to ask them about the stories anymore, they come over to me and say, "Mrs. Raine, do you want to know what this story is about?" Of course I say, "Sure!" They know I really care about them. This mutual respect for each other has helped me in other situations. For example, during a Science lesson the children really listened and paid attention to what I had to say. My behavior problems are slowly fading as the children realize that I am different. They told me they want me to bring more books the next time I come. Remember, it took three weeks to reach this point. You have to let kids know that what they think and feel is important and you care about what they have to say.

John Bates, in "Coaxing Children" makes the statement, "But when we permit them to do some writing and reading that is going to have a consequence for them - when they're going to see the look on the face of a person receiving the message - then there is an intent there and the kid gets right down to the serious business of living." He is so right. When my kids knew they could retell the story to me and share their interpretation of the story, it made all the difference in the world. They were sharing what the story meant to them in terms of how they were able to make sense of it through their interpretation of how the world is. I didn't need to ask comprehension questions, their retelling of the story was all I needed. I've started doing retelling of the basal stories, which works nicely as well.

Another point Bates brings out and I observed last week involves getting into the deep structure of a child's drawing or writing. He mentioned one student's perception of how a teacher looked at his writing was she didn't read the stories, she only marked them. Teachers needs to look at what the child is really trying to say. What I observed with one of my students relates to this point. The students had finished their work and the teacher was allowing them to do what they wanted. I read this article the night before so I asked the children who were bored to write me a note about something important to them. One student drew a picture of a space shuttle blasting off the ground, the planet Earth, and stars covered the entire page. When the space shuttle Challenger exploded, my cooperating teacher talked very little about it to the students because she said they were too young to understand. Many times teachers don't realize that what happens in the real world cannot be separated from school no matter how hard we try. This drawing reveals exactly what was on the child's mind and it wasn't school. I talked with him and he explained that this drawing was related to the space shuttle explosion. The student was a behavioral problem for the teacher that day, perhaps the drawing was a clue. He enjoyed explaining his drawing to me and I saw big smiles. I don't see these too often from this student. Bates is so right when he talks about the deep structure. Teachers have got to get to the deeper feelings of kids to know what they're thinking and how to help them. According to Bates:

> "...children should hear the rhythm of the language and the words of the language, and get a chance to let that bounce off their souls."

I wish this were true in schools today, but one has to face reality and this is not what is going on. It is what I tried to get started in "quiet reading time".



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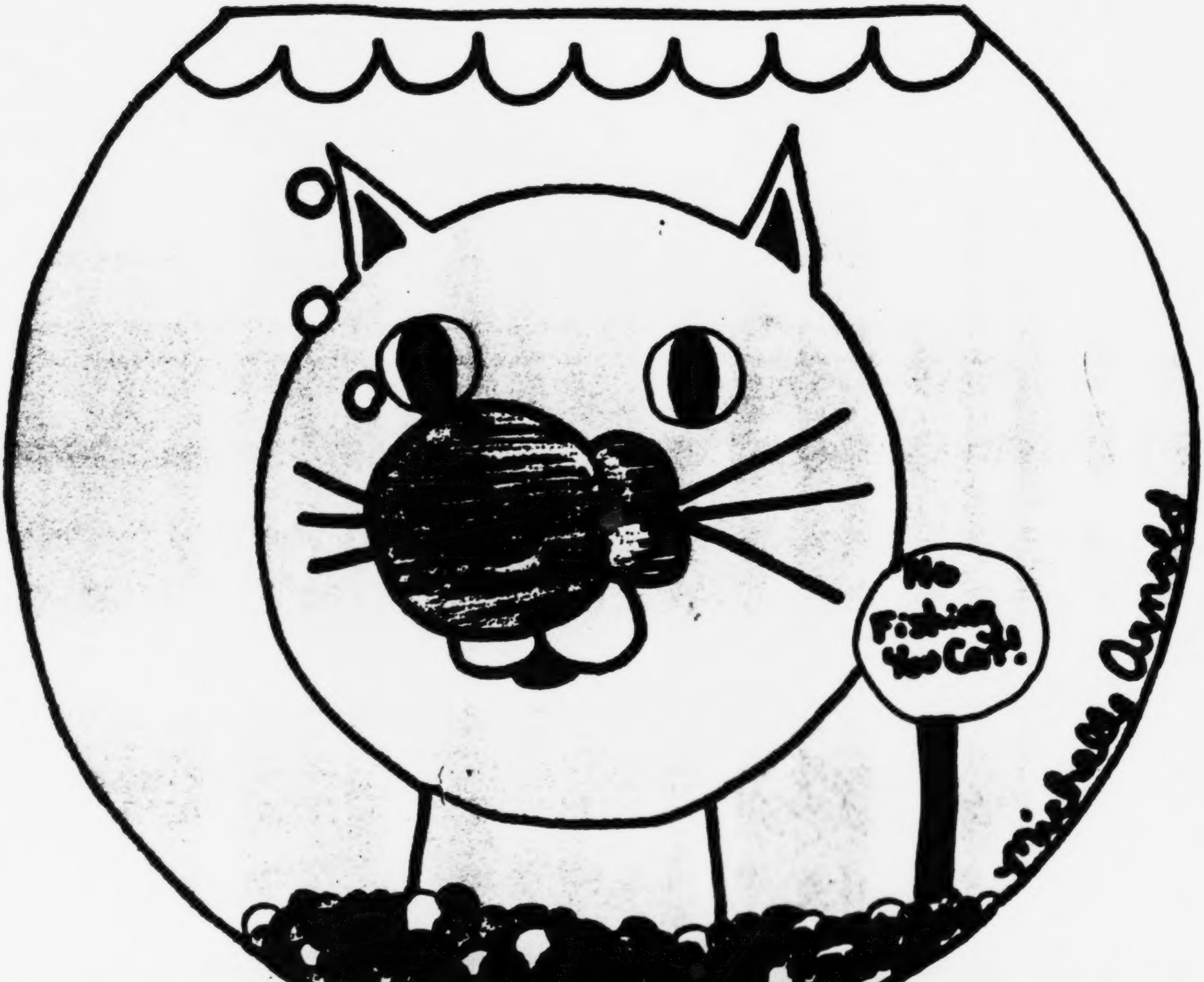
No Fishing You Cat!
Michelle Arnold

SEEDBED

NUMBER 26

JULY 1986

Teachers' Center Project

SIUE

**Southern Illinois University
at Edwardsville**

2721

INTRODUCTION

It's been a long time since the last SEEDBED! But now we are happy to produce not one but TWO new issues.

The present SEEDBEDs owe their being to many people.

Barbara Goldenhersh edited SEEDBED 25 and 26 (and begins now 27 and 28) with verve and thoughtfulness and care and a lot of late nights learning to cope with new technology. Thank you, Barb!

And thanks to our teacher-authors who have some very thoughtful and down-to-earth (but not so commonplace) ideas and researches and comments on children's educational growth and well-being. Special thanks to guest authors Hassler Whitney and Irwin J. Hoffman for their kindness to SEEDBED.

Major support was given to the present SEEDBEDs by Mary Steffen, visiting teaching fellow at SIUE, whose students contributed mightily here, and to Patricia Atkinson and Sheryl Favre, without whose good humor and hard work you'd see scrambled eggs.

And thanks to SIUE's Dr. George Kurtzrock, who allowed us use of a Mac computer and to Marge Kosel and Tom Prosen (Sunburst Communications) on whose equipment the present SEEDBEDs were printed.

The ideas are the same as those of the twenty-four issues we've already published: 1) KIDS COUNT and 2) Knowledge is not a spectator sport.

But the looks of SEEDBED have changed a bit. With lots of scrambling and late nights and borrowed technology and enormous goodwill all around, we are happy to make available SEEDBEDs 25 and 26.

The cover of this issue comes to us from Cheryl Smith, sixth grade teacher at Belle Valley South, who asked students to create animals using circles only. This is just a sample of the many creative children's art works submitted.

At the end of several articles throughout SEEDBED, you'll find some lovely problems to solve. Don't miss them! The problems come from Art Whimby and Jack Lochhead's PROBLEM SOLVING AND COMPREHENSION (A Short Course in Analytical Thinking), Franklin Institute Press, 1980. Run, do not walk, to buy the book!

T. C. O'Brien

Thomas C. O'Brien, Professor
Teachers' Center Project

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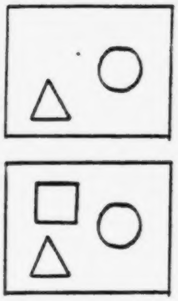
A NEW FLAG
Karen Haas



After reading an article in Seedbed #12 by Gay Rasler, I had a "brainstorm". She proposed the problem of a country designing a new stamp using three colors. I decided the country's new government also wanted a new flag. I gave the problem to my class--seven hearing impaired students, ages 10 to 13. At first (due to my misinterpretation of the problem) I gave them only one option -- to use four different colors to design the flag (purple, green, pink, and yellow). They began and from seven kids we got six different flags on our first attempt. Then, the ideas began pouring in and the flags came to be called "the pink ones and the green ones". By background color.

After looking at the background color the kids said, "Look at the circles next." And soon they had discovered the six possible combinations for each of the four backgrounds (using four colors), i.e. two flags in all. This initial step took about 45 minutes. Our principal came into the room and because my cooperating teacher and I were confused (after all, Gay Rasler's class found 27 combinations with three colors), we asked him if he could "see" any more possibilities. Since he could not, I reread the Seedbed article and found my mistake. The children had solved the problem as posed.

The next day I posed the real problem to the students: "NOW THAT YOU'VE FOUND ALL 24 OF THE FLAG DESIGNS USING 4 COLORS -- HOW MANY CAN YOU DESIGN USING ONE, TWO, OR THREE COLORS?" Enthusiastically they began working a half hour that day and using free time the next. They "designed" four one-color flags, 84 two-color flags, and began the three-color flags by making six!!! They are very good at "grouping" the designs to see what's missing...

SUCCESS!!! In 16 days! We finished our flags and decorated our walls. Even the principal has become attached to them. Would you like to know how many? Let me explain what the class decided was the best way to find out without counting each flag individually...

First, we finished the four-color flags and arranged them in columns by background color on a small bulletin board.

4 Columns
X 6 Flags each
*24 Four-Color Flags

Then, the children quickly made the 4 possible one-color flags.

* 4 One-Color Flags

Okay, so far we have:

24 Four-Color Flags
+4 One-Color Flags
28 Flags

But, what about the two and three-color flags that have "grown" on our walls?

Two-color flags...

Tina and Tammie: "We can count 28 columns and 3 flags in each."

28 Columns
x 3 Flags Each
84 Flags

Kristy: "Let's do it by background colors!"

7 Columns of Each Background
X 3 Flags Each
21 Flags

Jennifer: "Times 4 background colors."

21 Flags
X 4 Background Colors
*84 Two-Color Flags

That wasn't so hard! But our three-color flags had sprouted "roots". (See Diagram).

The class divided the problem where the columns became longer. They proceeded to calculate as follows...

Tina and Tammie: (Right Section) "Take 24 columns times 3 flags each."

24 Columns
X 3 Flags Each
72 Flags

Jennifer and Kristy: (Same Section) "Background color is easier!"

3 Purple Sections
X 6 Flags Each
18 Purple Flags
X 4 Background Colors
72 Flags

Both groups (Tina and Tammie) and (Kristy and Jennifer) then calculated the "left section". Also the other three students joined in the activity with varying degrees of involvement (one boy performed algorithms only).

Tina and Tammie: "8 columns times 9 flags -- that's 72!"

Jennifer and Kristy: "4 background colors -- let's see... 2x9 ... time 18 flags each:

18 Flags
X 4 Background Colors
72 Flags

Rusty, Jamie, and Jimmy: (From their seats) "Now ADD!: (Meaning the two sections.)

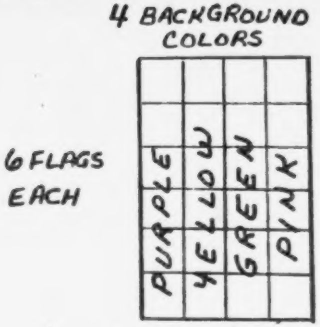
Jimmy performed:
72 Flags (Right Section)
+72 Flags (Left Section)
*144 Three-Color Flags

????How many flags have we designed????

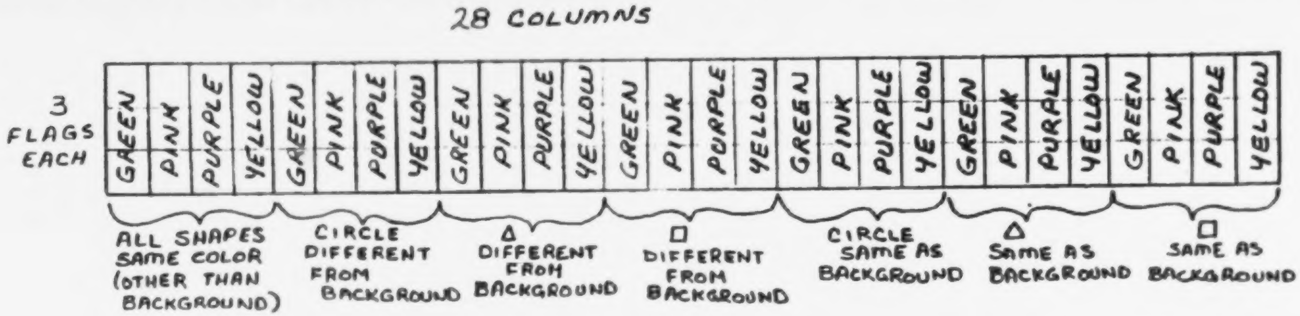
"ADD! ADD! ADD!"

24 Four-Color Flags
4 One-Color Flags
84 Two-Color Flags
+144 Three-Color Flags
256 Flags in All

Here's a problem for you, dear reader. How many flags if we have five colors?

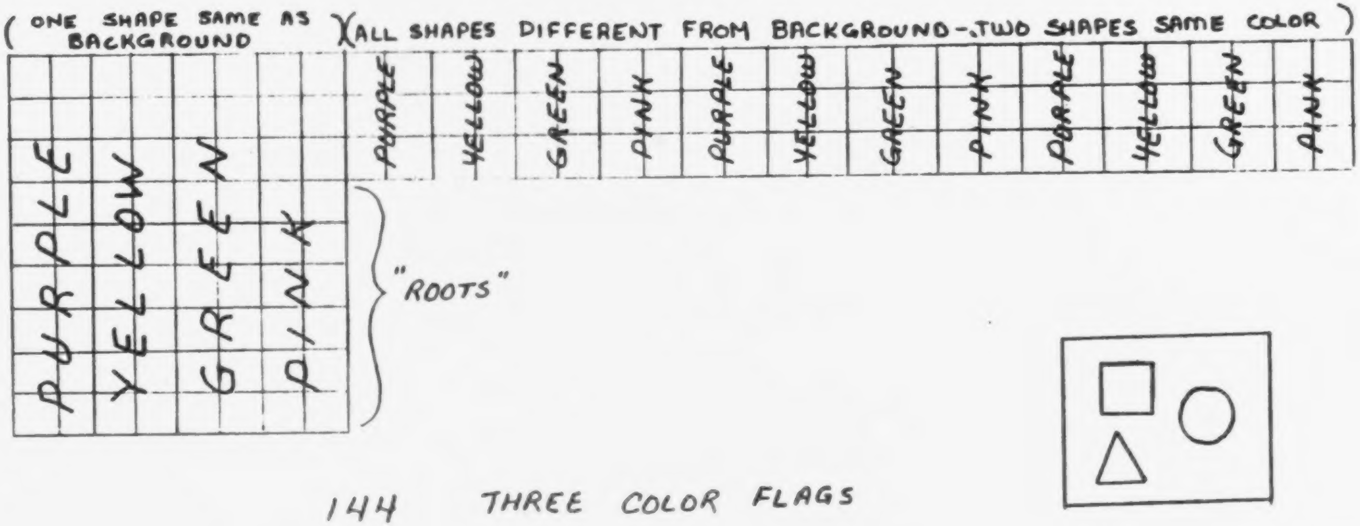

4 BACKGROUND COLORS
6 FLAGS EACH
PURPLE
YELLOW
GREEN
PINK

24 FOUR-COLOR FLAGS


28 COLUMNS
3 FLAGS EACH
GREEN
PINK
PURPLE
YELLOW
ALL SHAPES SAME COLOR (OTHER THAN BACKGROUND)
CIRCLE DIFFERENT FROM BACKGROUND
△ DIFFERENT FROM BACKGROUND
□ DIFFERENT FROM BACKGROUND
CIRCLE SAME AS BACKGROUND
△ SAME AS BACKGROUND
□ SAME AS BACKGROUND

84 TWO COLOR FLAGS

4 ONE-COLOR FLAGS


(ONE SHAPE SAME AS BACKGROUND)
(ALL SHAPES DIFFERENT FROM BACKGROUND - TWO SHAPES SAME COLOR)
PURPLE
YELLOW
GREEN
PINK
"ROOTS"

144 THREE COLOR FLAGS

EXAMPLE OF ONE FLAG

CHILD WATCHING EXPERIENCES
Patti Peters

Tasks -- Counting numbers, Asking, "What is math?" and Drawing a picture depicting the previous mentioned tasks.

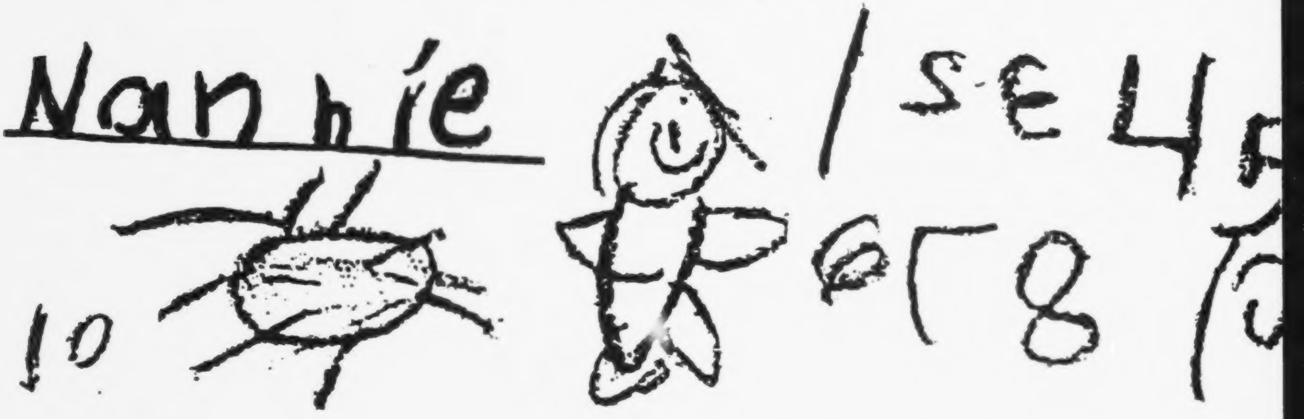
Location -- Walnut Grove Elementary School, Ferguson, Missouri.

Children's ages -- Kindergarten students, ages 5 and 6 years old.

Description of the three tasks and questions asked:

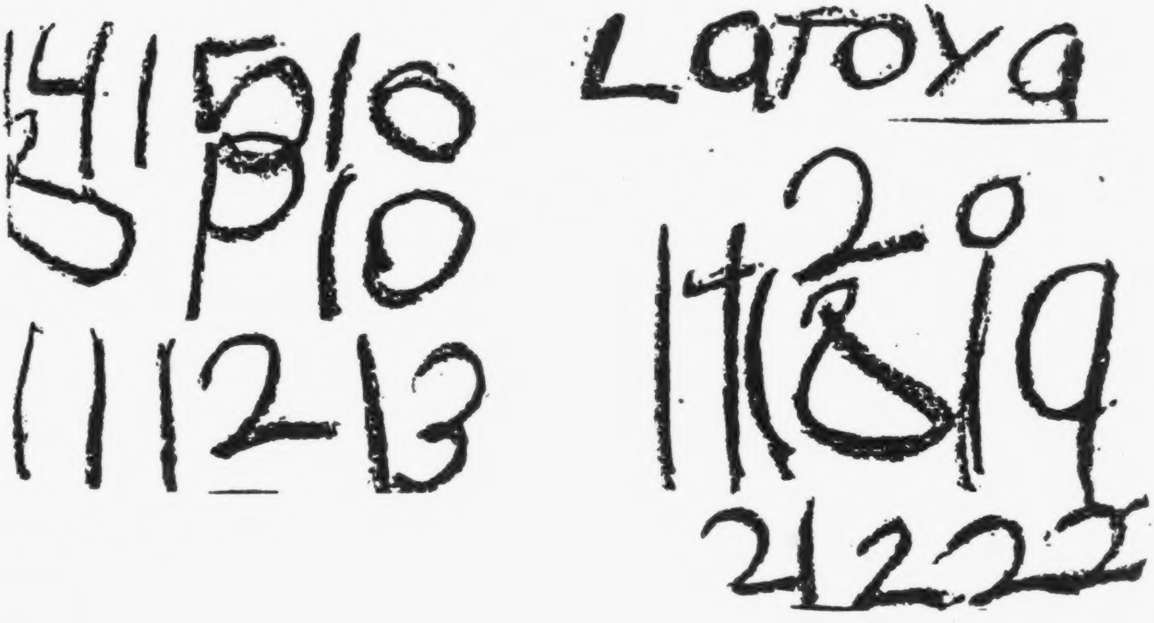
A: COUNTING NUMBERS

The original task was to have the child count numbers and to observe the way they conceive number and how they make the transition from one place value to a higher place value. (It was observed that children have a difficult time when they approach 99. The change from two to three digits is an important transition in respect to this age level.) The child was asked to start counting at a specific point and told when to stop. The numbers used were: I to I2, 42 to 53, 97 to I05 and were administered according to each individual child's ability. After this task, each child was asked to draw a picture to show how they counted the numbers. The following are some examples of the kinds of drawings I received:



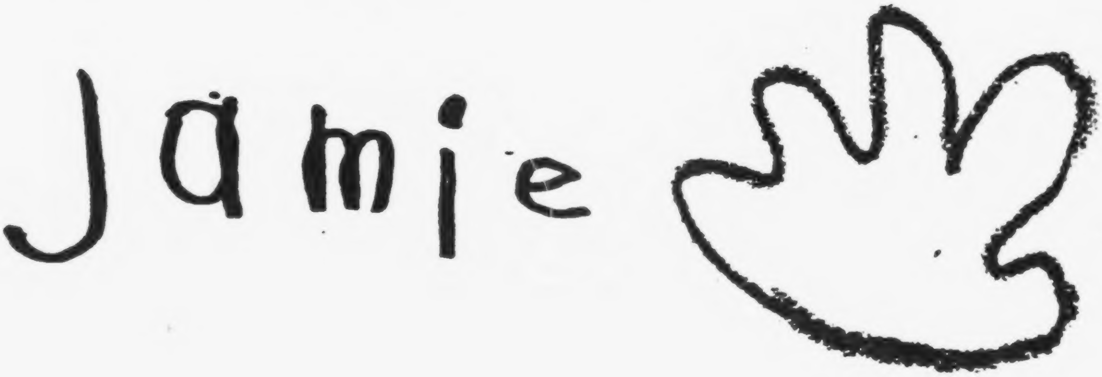
Nannie explained her drawing by telling me the numbers are what she "did", i.e. the counting she did, the girl she drew is "me counting", and the sun she drew was to depict "today is sunny".

The following is Latoya's concept of counting. She explains her drawing as, "It's how I counted. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 15, 16, I7, 21, 22, 23, 34, 35, 26, 27, 28, 29, 100. I can count more numbers. I can count more past I00."

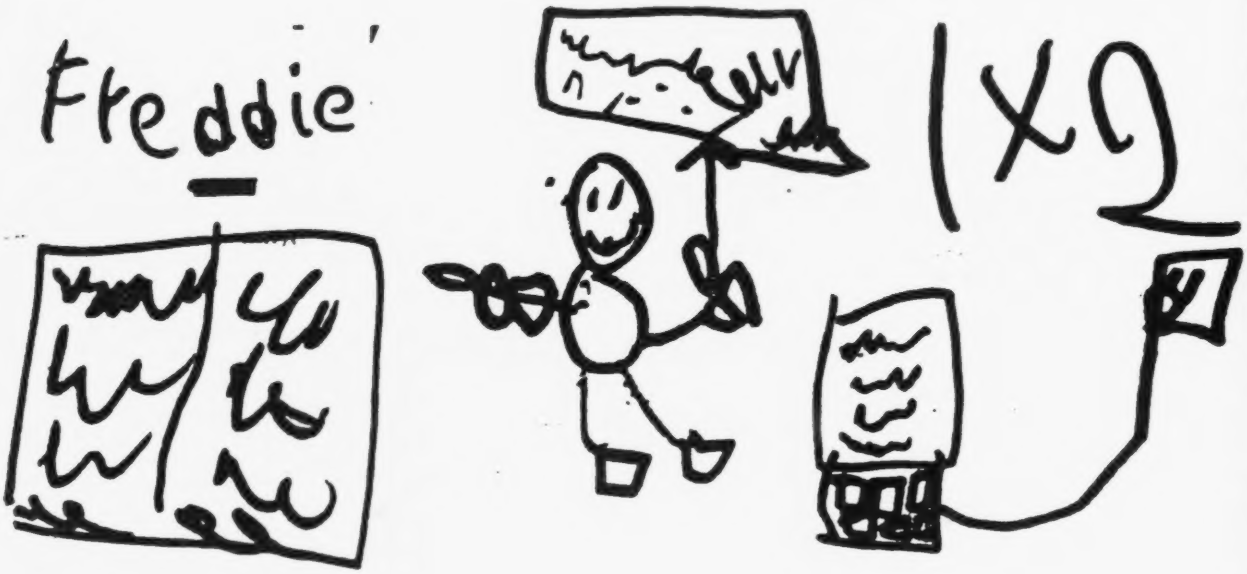


B. "WHAT IS MATH?"

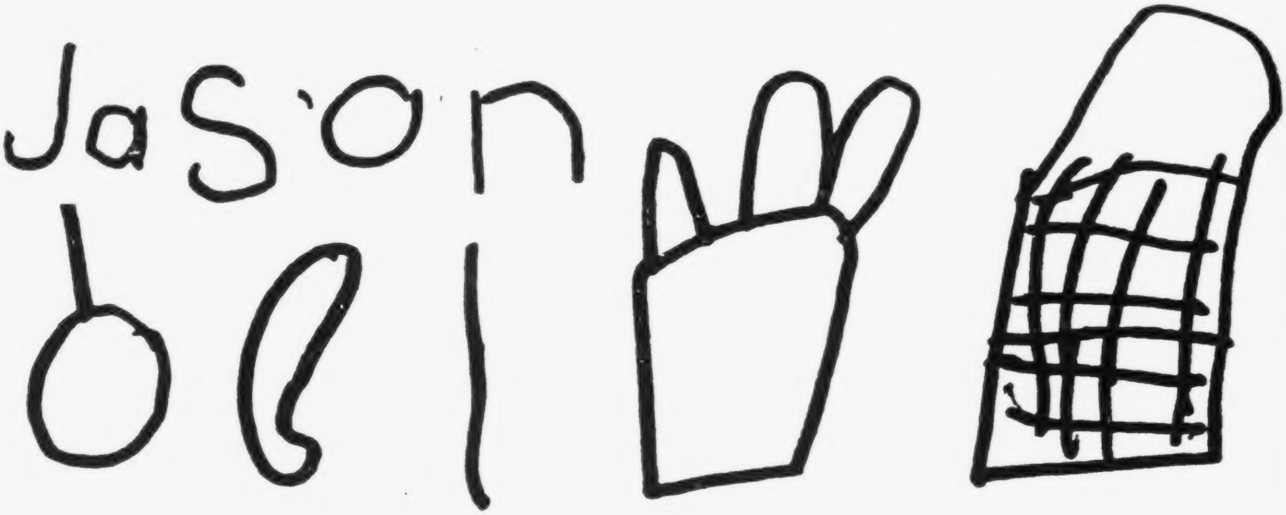
I asked the children if they could draw me a picture of what they thought math is, and then asked them to explain it to me from their drawing. The following material is a sample of the drawings and explanations I received.



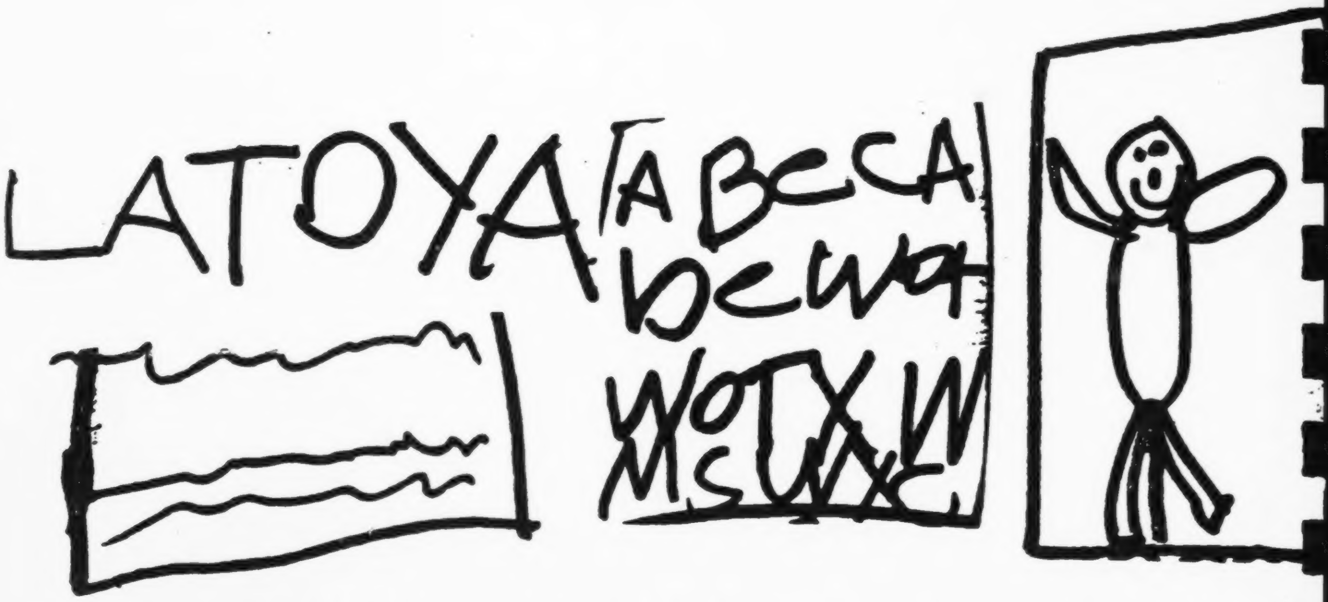
Jamie told me that the reason he drew a picture of a hand is, "It's my hand. It tells somebody I'm five. But now I'm six. Maybe,.. um ... I think I shoudda drew two of em.".



Freddie explained his pictures of math in the following way: "Mrs. Brown does the numbers on the board. One times two is numbers. A (gas) pump has numbers. We got to do papers with numbers."



Jason told me his drawing, "has one apple, one banana, one flower in a pot, one basket - I know it's supposed to look like that cause my mom's got one at home. I know all about stuff thats got numbers".



Latoya said that her drawing of math, "is good. I can draw. Yes, coloring something is math. Writing in books is math. These (letters) is math. I can do good math. Do you want me to draw some more? I'm not really done yet."

PERSONAL COMMENTS:

The drawings illustrated in this text are typical of the total materials I collected, in that they are prime examples of the children's different concepts of the issues examined -- concept of number and concept of math. The drawings indicate to me that we can often establish at what Piaget stage level a child is working in by carefully observing his version, i.e. drawing, of a specific task. I can see the difficulty a Kindergarten student often has when trying to reverse a task or operation such as counting in order that they can reconstruct the process on paper. A child may be quite competent in their activity and still be unable to remember or reconstruct the process in a drawing.

I often received drawings that, when explained, were totally unrelated to the test completed. The children gave me some very interesting insight into their personal life by drawing pictures of his brother, her best cat, etc. The drawings often reminded me just how egocentric a child can be at this age level, as they didn't seem to mind that their drawing had absolutely nothing to do with the instructions as to what they were to draw.

I think we as teachers should be more observant to an individual child's behavior and actions. We can use our insight to our advantage when teaching children, if we come to a better understanding of the way a child thinks and learns.

MY GAME OF TENS PATIENCE

SUSAN COBB

One activity I tried with some students while I was in my Field Experience was the 'Tens Patience' game--having the child arrange the numbers in order as much as posible when they are called out at random. (This game is the same as Racko.) I discovered when I tried this individually with students that they didn't seem too concerned about winning the game--with filling the blanks up as quickly as possible. There was hardly any motivation. My solution: I had to alter the game to create some competition.

I used three students and had them work together on one game. The main rule I laid down was that all of them had to agree on where to put a number before it was written down. This slight alteration in the game was all I needed. The children took off! I heard comments such as, "There's more to come after that number than before it!" or "This is the only place it can go!" They all had to interact together as they made their thoughts known. It was great! As a matter of fact, they all begged to play more games. We went on to play a few more games but I think all four of us learned many things from this activity alone. The children learned more about interacting and considering others' viewpoints. I learned that one mere alteration in a game can make all the diffence in being bored or being motivated to learn more.

Editor's Note: For readers who've not run across Tens Patience, it was brought to our attention by Bob Jeffrey in the 1980 summer course of the Teachers' Center Project.

PEANUT BUTTER THAT STICKS TO YOUR MOUTH

Beth Weisenstein

One way to involve children in learning difficult math concepts is by conducting a consumer report. The sixth grade class I worked with was active and interested. Five brands of peanut butter were used. The students constructed graphs, averaged, compared values, found how to find the better price, and discovered basic nutritional information.

Each student made a bar graph for each test. The tests included cost comparison, texture, taste, color appeal, label appearance, and nutritional comparison. They graphed each product on a scale from five to one, five being the best and one the least preferred.

When all the tests were completed, the results were compiled and the students averaged the results of each brand from each test in order to find the product which ranked the highest.

Students found how to check the price per gram of each product. They were asked how much a larger jar would cost using the information of price per gram for the same product. I brought in the larger jar, and it was cheaper than their prediction. We then discussed the advantage of buying larger products (if you use all the product).

The students also learned how to read and understand the nutritional information on a product. We compared calories, sodium, fats, carbohydrates, and vitamins and found which was a better value.

This multifaceted math activity takes an afternoon to accomplish, but, if you are interested in your children using math meaningfully, you can spare the time.

$14,500 FOR TEACHERS AIN'T PAY

Sydney H. Schanberg

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(This article, which appeared in the February 12, 1985 issue of the New York Times, is reprinted with permission.)

Because the public schools in this city are in trouble, because they are turning out almost as many dropouts as high school graduates, many worried people are trying to raise the public's consciousness about the problem.

None of the concerned teachers, parents, administrators, union officials or civic leaders suggest that there exists one magic answer. They all know that the problem has to be attacked at every level -- from salaries to curriculum, from more rigorous certification requirements for teachers to more rigorous graduation requirements for teachers to more rigorous graduation requirements for students, from better training in the new computer skills to better athletic programs. In short, we have to adopt a crisis mentality and try everything possible to raise the self-esteem and standards of everyone in the school system.

You might respond that you've heard all this before -- that there's nothing new in it. What's new is that more than 40,000 teen-agers are dropping out of our high schools every year.

It's no secret where they're going. The jobless rate here for all youths aged 16 to 19 is 25 to 30 percent. For blacks and Hispanics, it's over 50 percent. And young people without jobs translate into welfare and antisocial behavior and crime.

In a recent New York Times survey, when asked what would "help a lot" in reducing the city's crime, a surprising 74 percent of those polled said better schools, and 75 percent said more job-training programs for young people. Way down on the list were such hard-line ideas as the death penalty.

Tested programs to improve the performance of the schools do exist and can be replicated. What does not exist sometimes is the commitment at the political level and at the present blandly led Board of Education to engage in bold experimentation on an emergency basis.

One cannot examine, in a single brief essay, all the proposals for turning the schools around. So I have chosen to focus here on the limited question of better pay for teachers.

The starting salary for a New York City teacher is around $14,500 a year. Worse, when inflation is factored in, one finds that "real pay" has declined dramatically over the last decade -- from $8,500 in actual dollars in 1974 to roughly $6,500 in 1974 dollars now.

Other city employees earn much more at entry, even without the college degree required of teachers. Trainees entering the Police Academy, for example, make nearly $22,000.

Yes, we all know that money won't automatically fix anything and that throwing money at problems can be an abdication of hands-on responsibility. But $14,500?

How many college graduates do you know who are willing to work for $300 a week in New York City? That's asking a lot of idealism and altruism. On the one hand we expect teachers to lead our children into productive lives, and on the other we deny them a fair and productive wage. We demand the best but are unwilling to pay for it.

President Reagan, in his State of the Union Message last week, called for "making sure good teachers are rewarded for hard work and achievement through merit pay." This is the same President who keeps cutting aid to local education, including the Federal support for teacher training. And the Federal cuts have hit hardest at cities like New York because schools with the highest dropout rates receive a lower percentage of aid.

Donna Shalala, the president of Hunter College, is one of those who have best articulated the nature of the crisis. This column owes a debt to her efforts to light this fire.

Explaining why the system's failure has been allowed to continue, she said in a recent speech: "Those who determine priorities in New York -- the so-called power structure -- have no real stake in the system. We either don't have children or don't send them to public schools. The parents of the children in the public school system are not seen as a constituency to be reckoned with."

"I believe," she went on, "that we need and can get from this city and state a substantially stronger financial and political commitment to education than we now have. I also believe that the unions, the business and civic interests as well as the school community are ready for change. But only if we have a comprehensive program, a direction, a fearless vision -- and only if we make the case that education is the best economic development strategy this city and state can undertake."

It is hard to disagree with her.

PROBLEM SOLVING TOPICS CHOSEN BY STUDENTS

Cheryl Smith

Based on a study by Tom O'Brien and Shirley Casey printed in Seedbed #15, I had 100 sixth grade students write word problems that would fit the equation 6x3=18. I then categorized these 100 problems into various categories of correctness and appropriateness. My findings closely parallelled the results of the original study.

In reviewing my 100 responses I became interested in the topics the children chose to write about. It began to occur to me that the subjects that children relate to are not always the topics that are found in the leading mathematics textbooks. Following is an itemized listing of the topics my students chose to use and their frequency.

POPULAR TOPICS	TIMES CHOSEN
Money	16
Apples	9
Groups of People	7
Rows of Seats	7
Packs of Gum	7
Animals	5
Cartons of Soda	4
Jars of Things	4
Eggs	3
Marbles	2
Balloons	2

Other responses that were used included:

Baseball cards
Party guests
Flowers
Hamburgers
Bathing suits
Karate
Books
Concert tickets
Unicorns
Balls
Poker chips
Pizzas

Originally I intended to stop at this point and try to draw some conclusions from these findings. However, these findings only served to arouse my curiosity about the topics found in current textbooks. Having just completed a curriculum study of new 1984 and 1985 editions of the eight leading textbook series, I decided to scan the problem solving pages to see what topics they chose to use. Some of the topics my students chose were used occasionally, but in addition to those I found the following:

Nutrition
Oil transportation
Travel by stagecoach
Gold Rush Days
Needlepoint
Home remodeling
Banking
Skyscrapers
Airliners
Hiking
Recipes
Ski vacations
Kilowatt hours
Amusement parks
Ring toss
Mountain elevations
Sales commissions
Volcanic eruptions

Beading Indian belts
Professional football
Pulse rates
Antique cars
Golf course fees
Pirates
Carpentry
Diamond cutting
Travel agencies
Bowling scores
Coin collecting
Olympic scores
Lunar landings
Buttons

As you read over the above listing I'm sure you were formulating opinions as to the relevance of some of these topics to sixth grade children. You might also judge these topics with respect to a child's socio-economic status and to the sex of the child.

This was by no means a complete listing or a scientific study. My intentions were to provoke your thoughts and opinions on this issue.

Observations and Conclusions:

I. Despite the apparent maturity of sixth graders, the topics they chose were at a primary level. Could this possibly be because a child's only exposure to concrete materials is in the primary grades.

2. Teachers could possibly do a similar experiment to see what their students relate to and then use these topics or concrete objects for future classroom explanations.

3. The topics used in mathematics textbooks are often about situations that have no relevance to children.

4. Perhaps money is one of the best concrete manipulatives available to children.

5. Publishers of mathematics texts should survey children in a similar way in order to write problems at a child's level of interest. The textbook companies appear to strive for creative situations in their problems with lack of regard for the awareness of children.

6. Some of the topics chosen by publishers require in-depth lessons on the subject matter before the teacher can even begin to address the mathematics operations involved.

HOW DO I MEASURE UP?

Doris French

Children love to work in groups or with a partner. Using large sheets of butcher paper, have the children outline each other's body. Then let them measure actual body parts and write the measurements on their body outlines.

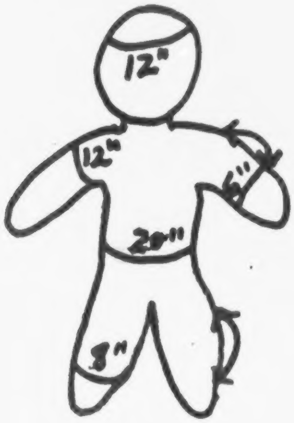
Measuring instruments could be measuring tapes, string and rulers, scale, and stop watch (pulse). Use of either measuring system can be specified. The various body parts to measure could be discussed first so as to encourage some variety (i.e. length of nose, size of smile, length of little finger, etc.).

A possible extension of this activity would be to have fifth and sixth graders work with first and second graders. Figures could be displayed around the room and in the halls of your building.

Pulse ______

Weight ______

Height ______



WHY DOES IT GET DARK AT NIGHT?

Bonnie Norman

This was a question we asked as one of our child watching tasks. I wrote the question on the board for a class of first graders. They are excited about expressing their ideas, not with spelling. See for yourself how a child's view of the world differs from that of an adult.

I also gave the same question to a combined fifth and sixth grade language arts class. The variation in their thinking is incredible.

Lea
the sungoes away.

becase the moon
is out and the sun
cant be seen R
o
b r
e t

---

becase when it's
night we sleep
But when it's day
we don't
Kirra

Because we wroldn
go to sleep.

EB
because sopeplop
canSleep

Maka
becausethe suncomes
intheevening.

For you can
speep. Br nnd on

Because if it was
stil light out we
wooden be ableto
sleep. Josh

Or else we wouldn't
ne win to gete sleep.
Jax

So you can sleep
Tim

Megan
Because the wrold
spins and it is dark
and on a nother prat of
the wrold it light
out

---

because theycan
sleep in bed.
Lisa

because it's just
is, dark because
it's light in themo
rning. KimP.

Wayne

10 5th

We only have 1 sun.

It gets dark at night because the earth rotates

Becky
12
6

It gets dark because the sun goes down and the earth turns and it becomes dark.

Jamie
11
5th grade

Donovan

because the sun rotates around.

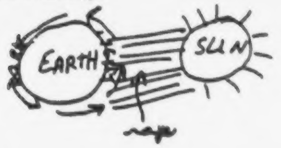
The reason why it get dark at night is that we only have one sun and we got to share it.

Caan Lee
11
5grade

The reason it get dark at night because if it don't get dark people will not sleep. ~~they~~ We can stay outside all day and play and the grown-ups can talk all day long and still ~~won't~~ wouldn't know it was dark

Lawrence
11
5th

It get dark at night because the sun stay in one place while the earth turns and so when the earth turns the sun shine on different parts of the earth.



Greg

Why does it get dark? Because the earth rotates around the sun so when its dark in China im Light in North America.

Marty

5th grade

Because the sun goes down And that gives us our light When the sun gone the lights

Whats this for anyway

Im rosie

Roger
13
6

Because the sun sets then it goes down and that's why it gets dark. There is one more reason people need rest at night.

David

age 13, 6th grade

It gets dark at night because the Earth Rotates and from the Cause of that, the sun goes down. When its Dark on planet Earth its light on planet jupiter.

Tracie
12 years Old
6th grade

It gets dark because at night the moon shines and at morning the sun shine when the sun shines the flowers bloom and the birds chirp.

Stacy
11

Tim

1995
W.D.I.G.D.A.N.

The Earth orbits around the Sun As it rotates it also turns. Because of the turning about half of the day we are facing towards the Sun, and the other half of the day we are facing the other direction. That's why it gets dark at night.

NAME - Charmise
Age - 10
Grade - 5

It gets dark at night so people can have a rest from the daytime.

Nicole

12 age
6th grade

Because the sun sets.

The Earth rotates 24 hours and is turned to its dark side Were the sun is on the other side of the of the Earth Example
Like when it is
When it is 12:00 noon PM on the other side of the Earth it is like 1:00 A.M.

Jerry
12
5th

FINGERS AND TOES

Renae Pontious

Practically every teacher (especially in math) has made some joke about students needing to use their fingers and toes to count. However, this is no joking matter to children up to the age of eight, and some older. These students are still in the concrete stages of cognitive thinking. Adding means "counting up" and subtracting means "counting down."

How many of us actually encourage this method? Many teachers teach math by memorizing facts. Some have even smacked children's fingers when they used them for counting purposes past the first grade.

I have observed that children, when denied finger counting, are usually creative enough to find another method for this concrete task. Some children look at their fingers to count them without moving them and thus arousing the teacher's suspicions. Others count imaginary dots in the air. (These are usually in a set pattern like the hearts on a deck of cards.) Some children use slash marks on a piece of scrap paper or actually draw little balls or balloons. If the teacher has a number line in the room, a student may count up and down it while doing addition and subtraction.

One of the more interesting ways of counting behind the teacher's back has been used by my own daughter. I noticed that when given a group of pennies or other objects to count she organized them by fives. I asked if there was a reason for her doing so. At first she did not understand my question. I asked if she counted things on her fingers or in her head. She told me that teacher does not allow big kids like her to count on fingers but she had a hard time if she didn't. Sometimes she was told to sit on her fingers so they wouldn't move. Frustrated, she stared at the clock on the wall and noticed that it had numbers and slash marks. So she began to use the minute marks on a clock for her counting. She is past this stage now and doesn't need to use the clock, but I would guess that instead of seeing an imaginary number line (as I do), my daughter will see a number circle that looks like the clock on a schoolroom wall.

My premise is that children need to count in order to make arithmetic their own. Instead of depriving children of concrete objects to count, we should encourage them. Let them count buttons, cars, seashells, spools of thread, students in the classroom!! Yes, let's even have them count fingers and toes!!!!!!

A PROBLEM IN CODE BREAKING

In a foreign language lev klula buj means "buy green peppers." However, words are not ordered as in English. For example, buj does not mean "peppers." Also, ajm buj gyst means "big green cars" and kluka lev ajm means "quickly buy cars." How would say big peppers in this tongue?

BEAD STRING GAME

Donna Loy

OBJECTIVE:

To use shape and color to verbally describe beads.

PREPARATION:

Seat two children so they are hidden from each other by a screen (or back-to-back). Use two laces and two identical sets of beads. Each set contains 12 beads of any three colors and two shapes. (For example: 3 cubes: one each in red, yellow, blue, 9 rounds: three each in red, yellow, blue).

Give each child a set of beads and a lace. Choose one child to be the leader. The leader chooses a bead on a lace and describes it. The other child must find a matching bead and string it on a lace.

After stringing six beads, children compare necklaces. If the necklaces don't match, start a new game. Repeated mismatches will require supervision.

Vary the game later by adding more beads to the sets or by having children take turns naming beads for the necklace.

DIRECTIONS FOR THE CHILDREN:

Do you think that (child's name) can make a necklace just like yours without seeing your necklace?

Choose a bead to string on your necklace. Describe it to (child's name). (Child's name) will find the bead in the box and string it on a necklace.

After you both have six beads on your necklaces, stop and see if the necklaces look alike. Will they look alike if you do a good telling job and a good listening job? Why?

DISCIPLINE VS MANAGEMENT PROBLEMS

Kara Lavoie

Through my classroom observations, I have noticed the difference between a discipline problem and a management problem. There are many classrooms which truly have discipline problems. The children are disrespectful, loud and out of control. In this type of classroom the students are usually trying to take control of a situation in which they are being constantly monitored and threatened. These children are "acting up" as a result of their need to be leaders and a need to make decisions for themselves. If these children are held down and forced to obey, they will either rebel or repress, neither of which is desirable.

Other classrooms have management problems. I have observed the children in these classes excited, involved and interested. Unfortunately, many people also find these rooms loud and "out of control". It is true that they may be noisy, but is this in itself a fault? The presence of noise does not necessarily result in the absence of learning. In fact, in my experience, it enhances learning. I do not think we have the right to expect children to be calm and quiet while also expecting them to be interested and enthused. It just does not work that way. Furthermore, I think the main reason noise is looked down upon is due to appearance. If the principal walks by the room, the teacher appears to have lost control. In reality, she is creating an autonomous room which takes time to develop ideas fully. A management problem can be a good sign if we can divert this energy and enthusiasm in positive directions. If we are successful, we are well on our way to creating a truly rich learning atmosphere. If we fail, the result is a discipline problem.

METRIC 21

Shirley Flath

I was teaching measuring with the metric system to a fourth grade class. While undertaking this task, I observed many things of interest.

I had mistakenly assumed that fourth grade students knew how to measure. I assumed too much. Even though the students had been required to bring rulers since first grade, no one ever showed them how to use them. I guess they are used to draw straight lines, as swords, or as desk stuffers..

I started with a pretest, worth I5 points, to see how much they knew. They had to name something a meter long, a centimeter and a millimeter long, tell me what m stood for, and then measure five lines in centimeters and millimeters. The highest score was one out of a possible fifteen!

I proceeded to teach the very basics. I gave them some history on the metric system and the English system. This hooked them. The history and their lack of knowledge on the pretest, (they did not see the results; I explained they were for me, to help me teach) really made them eager to learn.

We discussed how big a m, cm, and mm were. I showed them a mm and a cm on their rulers. I also showed them a meter stick. They took turns naming something a m long and measuring it. We went to a cm next, and then a mm. They not only enjoyed it, but learned from it. Having the children take turns naming and measuring objects in the classroom was time consuming but worthwhile since they could guess and verify their predictions.

The next day, after I looked over the pretest for totally funny answers, we discussed some of the mistakes since we now knew how long a m, cm, and mm really were. Some examples were: Mrs. Flath's fingernail = lm, a desk = I mm, the teacher's foot = I km. I was careful not to offend anyone and explained we were not laughing at anyone, but, when we do not know things, we can give funny answers.

We then played Metric 21, a card game in which the cards have lines ranging from I cm to I0 cm long (4 of each kind). After the cards have been dealt out to a maximum of four players per deck, the children need to estimate when their lines add up to 21. After they estimated, they were allowed to measure them to see if their estimations were correct.

The game was not only a success with the class, but was more beneficial than I had imagined. It really helped the students with their addition facts. The slow learners who had trouble adding simple facts were having little trouble adding columns of line measurements to see if they equalled 21. They had a reason to add that went beyond the ditto sheets. They were motivated by their desire to win the game and they lost their fear of numbers for awhile. They felt equal with their peers for in this game of chance, anyone could win, even the slow learners. I saw motivation at its peak. It was wonderful!

After the game, I gave a posttest. The worst score was I3/15. Play CAN be educational.

Directions for Metric 21

Materials: Deck of 40 cards. 4 each of cards with lines Icm long through I0 cm long.

To Play: Dealer shuffles deck for 2-4 players.

1. Dealer then deals each player two cards face down.
2. Each player can then ask for as many more cards as he desires.
3. The winner is the player whose total length of the lines on all cards in his hand total 21 cm without going over.
4. In case of a tie, the hand is played over.
5. A metric rule can be used to total each player's hand

HOW CHILDREN INTERPRET REALITY

Aggie Raine

Labinowicz (l980) points out that children are not mere cameras copying reality. They interpret and construct their reality. According to Labinowicz:

> "Rather than passively record a mental copy of reality, as a camera makes a physical copy, our minds actively interpret and construct a representation of it in the manner of a creative artist. Our mental image resembles a painting rather than a photograph of reality."

To prove this point I decided to do a child watching task suggested by Hans G. Furth (l970). According to Furth "knowing" (knowledge) is not a passive copy of "objective" facts. "Knowing" should not be interpreted as being the ability to remember facts, but is the ability to take facts and construct reality in a meaningful fashion.

The task Furth suggested was as follows:

(l) Take a match, put it half over the edge of a table, and slightly tap the overhanging part,

(2) Ask the child to observe-what happens, and

(3) Tell the child to draw the successive positions of the match as it flips over and finally falls to the floor.

Observe the drawings of the children on the following page. Furth (l980) concludes that the match moves like the child himself when he makes a belly flop into the water. The child is not able to see the successive turning around an imaginary axis.

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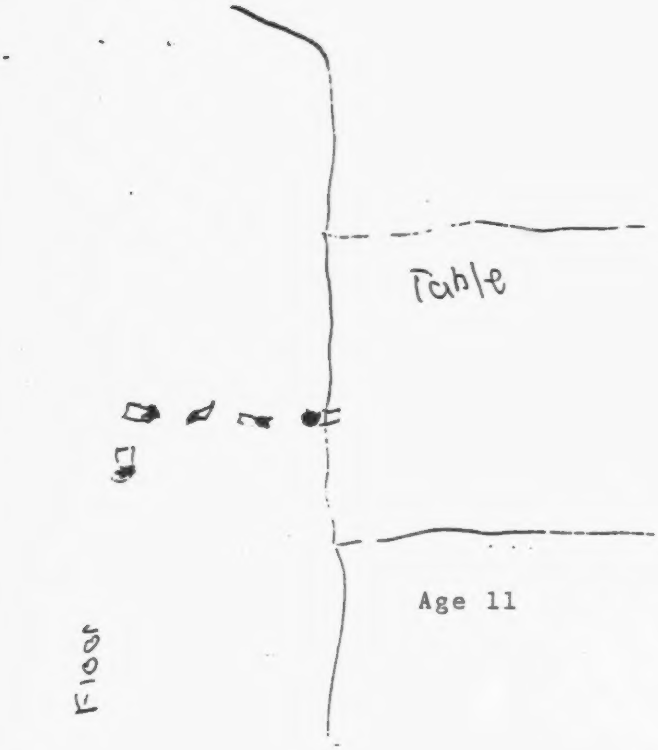
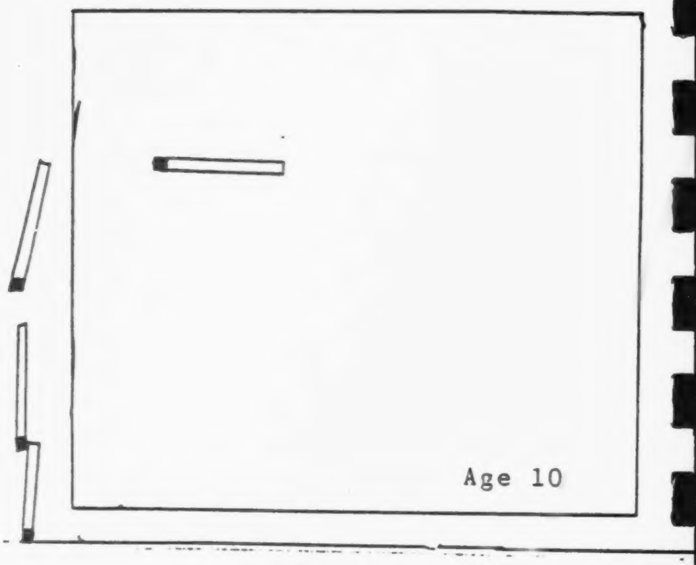
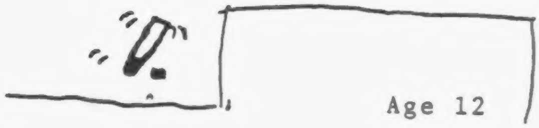


Table
Floor

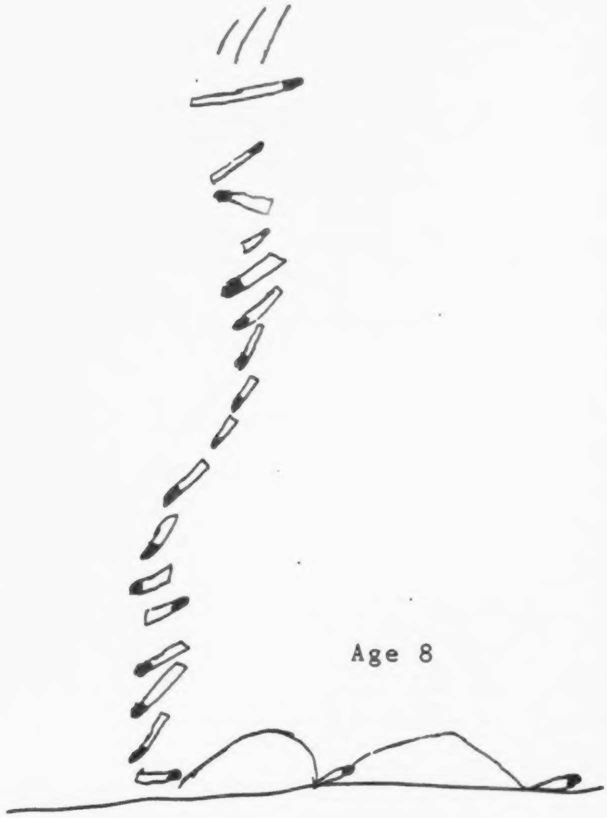
Age 11



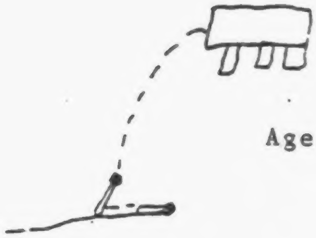
Age 10



Age 12



Age 8



Age 7

IMMATURE, BUT NOT LACKING

Gina Gehrs

The most immature child in my Field II (undergraduate) kindergarten class is a whiz at numbers. This is what I've found out recently through my observations. Jimmy, who just turned five years old, who can never seem to sit still, who can't hear beginning consonant sounds, is a really bright child. The other day my cooperating teacher selected Jimmy and another student to play dominoes with me because she thought these children needed special help with counting.

I could tell Jimmy had never played dominoes before because he had a hard time following the rules. As we were matching up dominoes that had the same number on them, Jimmy exclaimed, "Look, there's twelve!" Previously, we had only been counting up to six dots. I then asked him to identify seven through twelve dots in various combinations. I found out he could tell me how many dots were on the dominoes in a split second. I thought he had visually memorized what seven dots, etc. would look like grouped together. Remembering Jimmy had not played dominoes before, this explanation seemed unfounded. I asked him to count the dots on the dominoes. Jimmy had a set pattern for counting. He began counting at the farmost right dot and then counted the rows from right to left.

Looking back at my observation notes, Jimmy was the child that knew the most about the Hidden Chip Experiment. (In this experiment, I placed a certain number of chips under my hand. The child was asked to look at the remaining chips and inform me how many chips were under my hand.) I could not fool Jimmy. After he successfully named the numbers of chips under my hand using five chips total, I began using ten. At first I thought he was making good guesses, but then I watched him more closely. First, he touched each he could see. Then he held up fingers for each chip that was missing until he got to ten. After about five tries he no longer used his fingers and would just recite the answer. His behavior turned out to be quite different from that of a child aged four years nine months.

I showed my findings to the teacher I am working with. She was quite surprised and said that perhaps Jimmy will make it through this year after all. She was thinking about retaining him because of his lack of attention and problems with letter/sound relationships.

If the fifth letter in the word sanctuary is the eighteenth letter in the alphabet, circle it. Otherwise, circle the letter (in the word) which is the fourteenth letter of the alphabet.

COUNTING FINGERS?

Kamilla Krummel

The following are statements made by classroom teachers in response to the following statement: The reason I feel students should or should not count on their fingers is . . .

"I feel student should count on their fingers if they need to. At this level they naturally do it because they need something concrete to work with. I don't teach it." (1st)

"I feel students should only use their fingers to count until they understand the concept of number facts using the powers of addition and subtraction. Children should be able to think about the facts rather than use their fingers to count. We need to teach children in order that they may finally use abstract thinking processes." (1st)

"At this grade level I allow them to use their fingers. Hopefully, with enough practice, they will be able to memorize these facts." (2nd)

"At second grade level some students at the start of the year need concrete objects to manipulate in Math -- and what is more convenient and always available -- fingers!! By Thanksgiving they should have mastered all + - including 10's to receive any grade above a C-." (2nd)

It's too time consuming to use fingers each time. It discourages them from memorizing." (3rd)

"By this time, the student should be able to visualize in their mind the 1-1 relationship of numbers to objects. However, at a K or 1st grade level. I feel it is fine to reinforce the 1-1." (4th)

"At my grade level no. They should be proficient at their basic facts. Using their fingers slows them down and prevents them from thinking quickly." (5th)

"The children I teach have problems learning their math and need the reinforcement of kinesthetic/visual channels along with the auditory, in short, "all the help they can get!" I let them do this as long as they seem to need it. It will go away and be replaced with less movement when the child feels self conscious doing it. I don't mention it. (An LD teacher K-8.)

This survey showed these teachers felt the use of fingers in a math class was unrelated to the construction of mathematic facts. The teachers seemed not to realize what the importance of mathematics is. It is not the ability of speedily throwing out facts. It is not the ability of superior memorization. It is the concepts in mathematics, the processes, understandings or knowledge needed to deal with real life situations. Why shouldn't students be allowed to count on their fingers!

"WELL, WHAT DO YOU THINK WE SHOULD DO ABOUT IT?"

Judy Klopfer

The workshop this summer triggered a small, yet significant, memory for me. The event occurred shortly after I graduated. With my secondary teaching certificate in hand, I began substitute teaching, the only position available at the time. The majority of my "subbing" career took place at the high school level. Then one morning I got a call asking me to fill in at the elementary level. While at the school, I noticed a large, bearlike male teacher. The smallness of the students made him appear even bigger. In my mind I deemed him "the gentle giant". The little ones trusted him and looked up to him. Several times during the day, I saw them come to him with their problems. Each time he would listen sincerely and at the end of their explanation he would quietly say, "Well, what do you think we should do about it?" Such a simple question, yet such a powerful one. He was teaching those children to be problem solvers and to think for themselves. The very same lesson that was being taught this summer. As a teacher, I no longer have the answers to give: I have the appropriate questions to help lead them to the answer.

On a certain day I ate lunch at Tommy's, took out 2 books from the library (The Sea Wolf and Martin Eden, both by Jack London), visited the museum, and had a cavity filled. Tommy's is closed on Wednesday, the library is closed on weekends, the museum is only open Monday, Wednesday and Friday, and my dentist has office hours Tuesday, Friday and Saturday. On which day of the week did I do all these things?

HOW TO SOLVE IT
Joyce Bishop

HOW TO SOLVE IT (A New Aspect of Mathematical Method)
G. Polya
Princeton University Press,
Princeton, New Jersey
2nd Edition, 1957

Polya offers a plan for what most of us do in a haphazard way, problem solving. It reads like common sense, but common sense organized and analyzed. It makes me think of the SQ3R method for reading: survey, question, read, recite and review. In fact, there are some parallels. Survey and question correspond to the "understanding the problem" section and review resembles the final "looking back" step.

I imagine that if a teacher would thoroughly absorb these steps, and apply them to every problem he or she confronted in the math classroom, not rigorously but in a comfortable manner, in a year's time the students would demonstrate a marked improvement in their approaches to solving problems. They would not have to approach a problem empty-handed, but would be equipped with a tool that would encourage them to explore the problems thoroughly to begin with and then gather every resource they possess that might help. Once finished the "looking back" section squeezes that last bit of benefit from the problem.

This is G. Polya's list of steps for solving problems:

HOW TO SOLVE IT
pp. xvi, xvii

UNDERSTANDING THE PROBLEM

First: You have to **UNDERSTAND** the problem.

What is the unknown? What are the data? What is the condition? Is it possible to satisfy the condition? Is the condition sufficient to determine the unknown? Or is it insufficient? Or redundant? Or contradictory? Draw a figure. Introduce suitable notation. Separate the various parts of the condition. Can you write them down?

DEVISING A PLAN

Second: Find the connection between the data and the unknown. You may be obligated to consider auxiliary problems if an immediate connection cannot be found. You should obtain eventually a **PLAN** of the solution.

Have you seen it before? Or have you seen the same problem in a slightly different form?

Do you know a related problem? Do you know a theorem that could be useful?

Look at the Unknown! And try to think of a familiar problem having the same or a similar unknown.

Here is a problem related to yours and solved before. Could you use it. Could you use its result? Could you use its method? Should you introduce some auxiliary element in order to make its use possible? Could you restate the problem? Could you restate it still differently? Go back to definitions.

If you cannot solve the proposed problem try to solve first some related problem. Could you imagine a more accessible related problem? A more general problem? A more special problem? An analogous problem? Could you solve a part of the problem? Keep only a part of the condition, drop the other part; how far is the unknown then determined, how can it vary? Could you derive something useful from the data? Could you think of other data appropriate to determine the unknown? Could you change the unknown or the data, or both if necessary, so that the new unknown and the new data are nearer to each other.

Did you use all the data? Did you use the whole condition? Have you taken into account all essential notions involved in the problem?

CARRYING OUT THE PLAN

Third: Carry out your plan.

Carrying out your plan of the solution, check each step. Can you see clearly that the step is correct? Can you probe that it is correct?

LOOKING BACK

Fourth: Examine the solution obtained

Can you check the result? Can you check the argument? Can you derive the result differently? Can you see at a glance? Can you use the result, or the method, for some other problems?

Cathy knows French and German, Sandra knows Swedish and Russian, Cindy knows Spanish and French, Paula knows German and Swedish, If French is easier than German, Russian is harder than Swedish, German is easier than Swedish, and Spanish is easier than French, which girl knows the most difficult languages?

Hint: Begin by making a diagram showing the order of difficulty of the languages.

PROCESS, NOT PRODUCT

Kathy Paul

Schools today overemphasize the end product of a student's reasoning and do nothing to reward the thinking process involved. We, as teachers, might productively rethink our own philosophies and realize how very important process is.

I had a class this quarter that helped me understand how important children's thinking is. This was the first time I had actually paid attention to how children get their answers, instead of to the answers themselves. Many of my classes have mentioned this importance but few gave me the opportunity and experience.

What an experience this can be! There's so much to learn from children. Observing them think is a wonderful place to start. This is a lifelong endeavor, and one I intend to use forever. I have only made a beginning.

Right or wrong needn't be the issue when so much can be learned: origin of mistakes, unknown strengths and weaknesses, original ideas, interests and dislikes, consistencies and dissenting views. This information is far too important not to be given attention.

How can we take time to observe children's thinking in an already packed day? It can be done! Talk to children and encourage them to talk to you. Go beyond standardized tests. In general, get to know your kids. Make an effort to understand HOW they think instead of condemning WHAT they think. It's worth the effort for a whole new perspective on "teaching".

NUMBERS IN P.E.

William M. McDaniel

Physical Education lends itself to a wealth of opportunity for students to practice counting, adding, subtracting, greater-than and less-than. A lot of activities and games already contain an abundance of numbers. Many children love to keep score. Their competitive spirit demands to know the score, who's winning, and how much we are ahead or behind?

To divide a class up for a softball game, "numbering off" is an excellent way to separate the class and set up a batting order. The even numbers could play against the odd numbers with the batting order from lowest to highest number. Listening and comprehension can be checked out by changing the teams from game to game just by changing instructions such as number off and separate by the half way number, then batting order could be from highest to lowest. Many other options are also possible with other combinations of instructions. Numbering off works very well in dividing teams for all kinds of games and sports. When there is no need for a batting or kicking order, the numbering off could vary. Instead of everyone having their own number, the numbering off could be any even number. If you number off by fours, the teams could be l's and 2's vs. 3's and 4's, or l's and 3's vs. 2's and 4's, or l's and 4's vs. 2's and 3's. So you see how the possibilities become seemingly endless. Another advantage of numbering off is the random selection usually produces some pretty even teams.

Some of the games where score is kept are: football, soccer, volleyball, basketball, softball, speedball, track and field, and floor hockey. With a little imagination and fore-thought, many other games (real and invented) can be used to stress counting, addition, subtraction and greater-than or less-than. As an example, I have used a game I invented which I call "Hot-Potato-Ball." We use red playground balls, brown soccer balls, white volleyballs, orange basketballs and a volleyball net. After dividing the class into two teams, one team on each side of the net, a number of each of the balls are distributed to each team. At the word GO, the game begins as each team tosses the balls (hot potatoes) over the net to the other side, not wanting the hot potatoes to be on their side. When the whistle blows everyone must stop tossing and freeze. Anyone with a ball must hold it up, so it is visible to everyone. The balls are counted by the students with the following values:

	Point Values		
	Kdg-lst	2nd-4th	5th-6th
red playground balls	1	1	1
white volleyballs	2	3	4
brown soccer balls	3	5	7
orange basketballs	4	7	10

Even first graders and kindergarteners are able to add up the scores, which is really quite a complex task. The team with the lowest total of points is the winning team and likewise the team with the highest total of points is the losing team. Besides making many complicated mathematical concepts seem like fun, the skills of catching, throwing and teamwork (cooperation) are developed.

Another game I like to use as a lead-up to softball and kickball is a game I dreamed up called 'Throw Ball.' I use this for kindergarten through third grade to teach running the bases, as well as throwing, catching, and cooperation skills. We divide the class into two equal teams and set up in a similar fashion to baseball or softball. Using a tennis ball or wiffle ball, the throwing team gets to go through their order. Each player gets to throw the ball as far as they want into fair territory and then proceed to run the bases in proper order. Each base tagged by a player after throwing the ball equals one point for their team. A thrower-baserunner continues tagging the bases in proper order until their turn is over. A player's turn is not over until they are tagged by a player on the other team holding the ball, home plate is stepped on by a player from the other team holding the ball, the thrower-baserunner runs the wrong way or out of the baseline, or the ball is tossed into foul territory. It is possible for a thrower-baserunner to run around the bases and their turn still not be over. They can keep going around the bases again piling up more points until their turn is finally over. The throwing team must keep track of their points compiled. When everyone has had their turn to throw and run the bases, the other team gets to come and take their turns. The team with the highest accumulated total is the winning team.

Numbers appear in so many P.E. activities, it would be a shame not to take advantage of the opportunity and use these situations to improve each students mathematics skills.

As long as sportsmanship and cooperation are stressed, emphasizing numbers can also help students who might not be as physically gifted as other students, but are mentally sharp. By staying on top of the score and being quick to add up points or determine greater-than or less-than, these students become desirable to have on the team. They are able to earn respect and admiration even though they might not be the best at throwing, catching, kicking, running or whatever.

With a little forethought and planning, P.E. activities can also be adapted or geared to help teach or practice the alphabet, geography, science, zoology, history, and many other subjects.

In closing, my opinion is that we need to include mathematics in our P.E. activities as best we can. I'm sure not every teacher will be the same or not every class capable of handling the same level of mathematics, but even on a simpler or less complex level, they too should be exposed to as many mathematical experiences and opportunities as possible. There is always the possibility that a student may not have understood or mastered a particular mathematics concept, but something may click during a P.E. activity that helps make this concept clear and understood. I think we need to give students every possible opportunity to learn, no matter how different or radical the method might be.

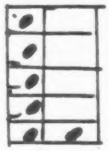
VISUAL PATTERNING
Bonnie Norman

This activity with patterning came from Learning From Children by Ed Labinowicz. His suggestion that children do not picture numbers in patterns interested me. He further suggests that patterning can be a useful tool for learning number relationships. Since his observations were based on children at the end of first grade and I am currently observing a like situation; I decided to try it. Following are my observations:

I began by giving each of six children a ten-square grid. (All grids used are pictured on the last page.) I then asked them to take ten pennies each from a bag and pass it on. Most of the children counted them by ones out of the bag. Robbie wasn't sure of his count and grouped his pennies in 3's in front of him; counted by threes to nine and asked for one more.

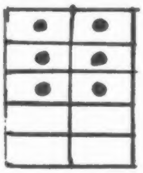
I then said, "use 6 pennies and place them in squares on your grid. Does anyone have the same pattern?"

The two boys did. Two of the girls had another pattern, and the other two another. We looked at Megan and LaDonna's first and I asked, "How does this remind you of a way to make 6?" Elizabeth said it looked like 7. She was opposite the paper which looked like this:

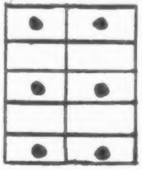


A very good answer. We then counted the pennies in each column to determine if there were six and came up with the relationship that 5 + 1 = 6. The children then said the others were 4 + 2 = 6 and 3 + 3 = 6. LaDonna said you could count by 2's in Robbie's pattern to get to six. I then asked them to make another pattern of six they thought would be the easiest to count. They recorded on their papers. Three of the girls and Tim recorded the 5+1=6 pattern. Robbie recorded a counting by 2's pattern that we hadn't seen earlier. LaDonna's was just scattered pennies.

Robbie's first pattern



Robbie's second pattern



We then added two pennies. Everyone counted by ones from one to determine that we now had 8 pennies. The children were to make patterns for 8 and see if anyone had the same. This time it was easier for the children to pick out number sentences from their grids. The most obvious one was 4 + 4 = 8 pattern.

I then asked them to make a pattern for 5. Robbie and Elizabeth took 3 pennies off their grids. All of the others took all of the pennies off and recounted to five. They had lots of different patterns this time; most of them were scattered around the grid. Elizabeth put hers all in one column and when they recorded the easiest pattern for 5, 3 out of 6 of them chose that pattern. No one mentioned that $5 + 0 = 5$. When I asked about it, they seemed bewildered as to why we'd talk about zero.

I then asked them to make a pattern with 10 pennies. They all remembered that was how many they had started with so they grabbed all the rest and went to work. As they worked, I asked them to look around when they were finished to see if anyone else had the same pattern. They seemed genuinely surprised that everyone's was the same.

Finally, Jennifer said, "They have to be the same, there are only 10 places to put them."

We then worked with the paper on which the grids were already filled in to see what relationships they could see. Many of them recognized patterns they had already made and could pick out the number sentences shown; but never related them to any other number. When I asked questions like what is one more than four, one less than seven, two more than five; they could come up with the answer, but didn't seem to conceive any of these on their own.

In the second session, we looked at a paper with grids with dots both inside and outside the grid. We talked about how many dots were inside, how many dots were outside, how many empty spaces, and how many dots altogether. I asked them to try to say number sentences for each grid. They did not picture the numbers from the patterns in the grids and counted them by ones for the first four grids. Maka then suggested that you could count by two's. But in every grid, after we had identified the number inside and outside, the children went back to count them again before giving an oral number sentence.

These are all first grade students who are nearly finished with the school year. They have been taught number facts all year. In LEARNING FROM CHILDREN, these activities are suggested for teaching children to discover patterns and relationships with numbers before they are taught arithmetic notation. The results of these observations support Labinowicz's proposals. It seems more important for a child to see relationships and conservation of number rather than be required to memorize and record number facts. Try this activity with first or second graders early in the year to determine their thinking before requiring them to memorize.

Note: This activity was used over the course of two thirty minute sessions as part of my field experience. The children participating were the highest of their class of twenty-one.

THE LOGIC OF COUNTING

Debra E. Huffman

Sonya, a 9 year old in the 4th grade, was asked to count a series of numbers. The numbers 1-12, 42-53, 97-105, 115-125, were all recited correctly. I then asked her to begin counting at 997 and continue. After the number 999 she said ten hundred, ten hundred and one, ten hundred and two, ten hundred and three, etc. Actually, 10 hundreds is one thousand isn't it? The decision has been made that we do not say the logical "ten hundred" but should in fact say one thousand. This is illogical to the student and they must learn by rote memory that the correct number in the thousands begins with saying "one thousand" and continuing with "two thousand", "three thousand", etc. This reminds us of saying thirteen instead of the logical "three-teen", or that after 10 should be "one-teen", "two-teen", etc. *(or onety-one, onety-two, etc. - editor's note)*

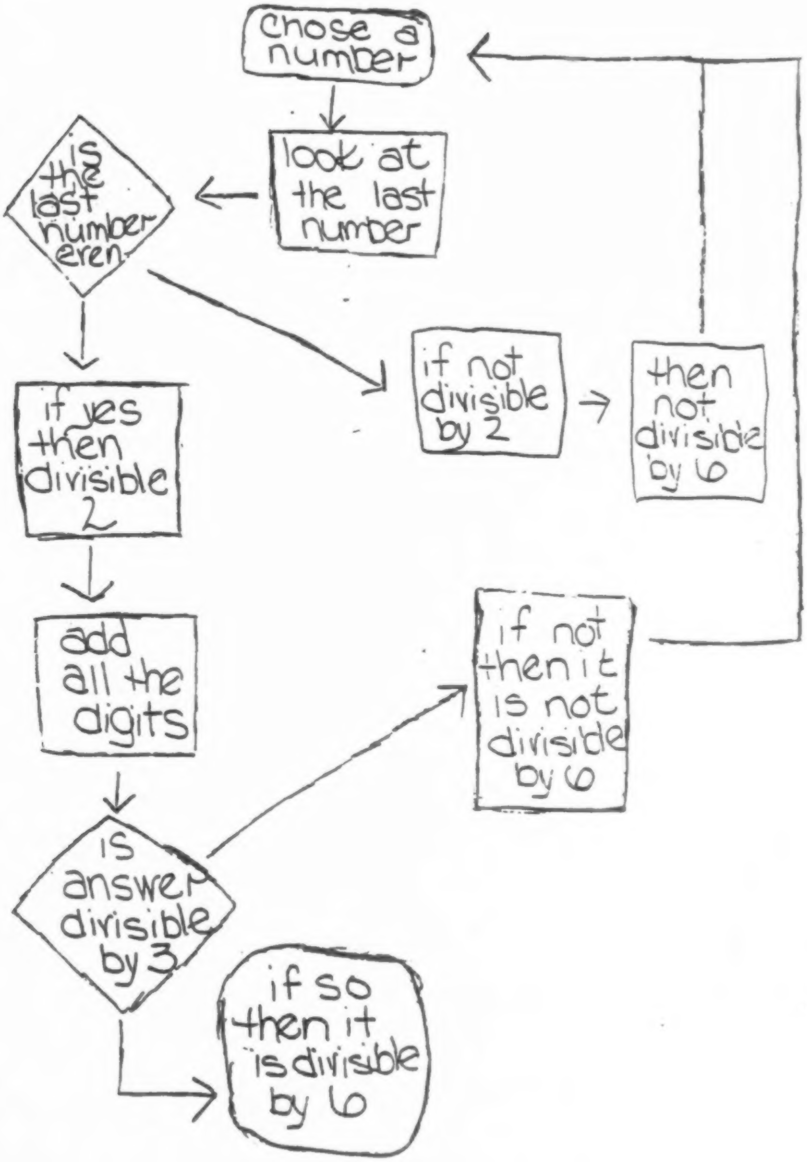
When asked to begin counting at 1993 and continue, she came to two thousand and said "one thousand-ten hundred". One thousand-ten hundred is, after all, really the number two thousand. It was only in the transitions from the 99's to the next unit where she consistently made mistakes (with the larger numbers that is).

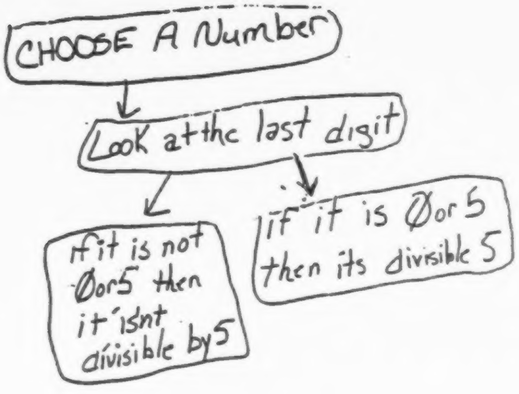
From 9983 on to 10,000 she instead said 10 thousand 10 hundred. Following the logic of her previous number counting this makes sense except that this is really the number 11,000.

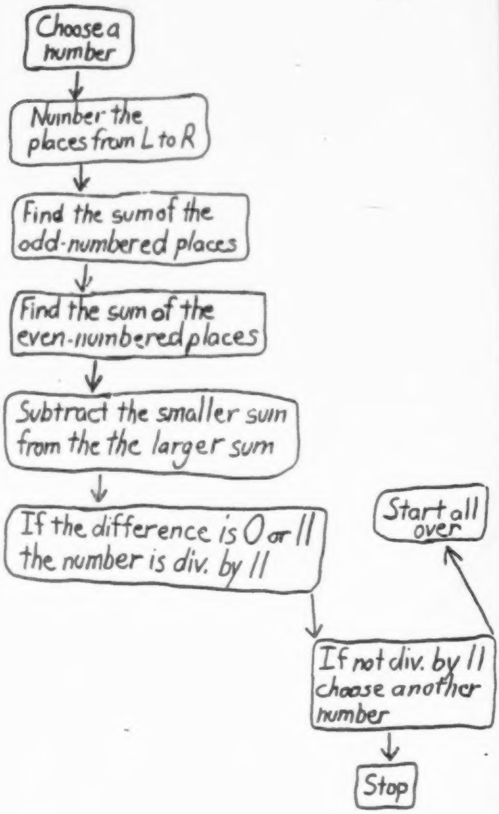
Her logical assumptions of number make a great deal of sense and should not be ignored by teachers looking for the right answer.

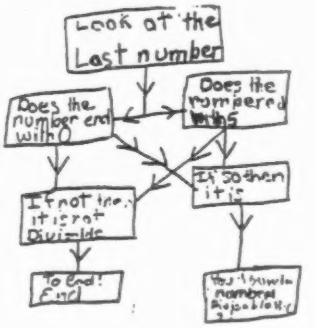
GO WITH THE FLOW
Sharon McCormack

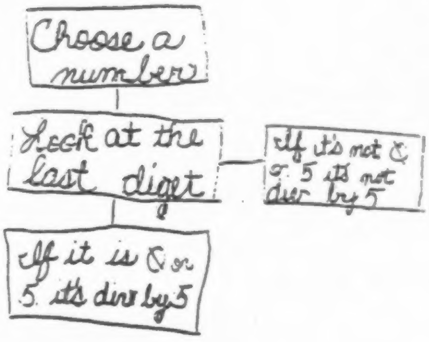
After discussing divisibility with my math class, I asked the students to make flow charts to show me how much they understood about divisibility by 2, 3, 5, 6, 9, 10, and 11. They had fun drawing the diagrams and I learned this is a way of observing their thinking. Following are some examples of what they produced:

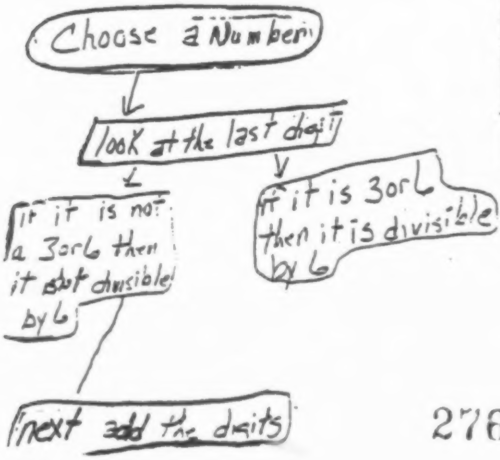

chose a number
look at the last number
is the last number even
if yes then divisible 2
if not divisible by 2
then not divisible by 6
add all the digits
is answer divisible by 3
if not then it is not divisible by 6
if so then it is divisible by 6

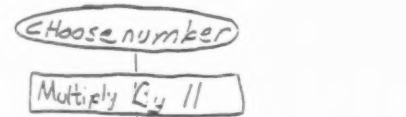

CHOOSE A Number
Look at the last digit
If it is not 0 or 5 then it isnt divisible by 5
if it is 0 or 5 then its divisible 5


Choose a number
Number the places from L to R
Find the sum of the odd-numbered places
Find the sum of the even-numbered places
Subtract the smaller sum from the the larger sum
If the difference is 0 or 11 the number is div. by 11
Start all over
If not div. by 11 choose another number
Stop

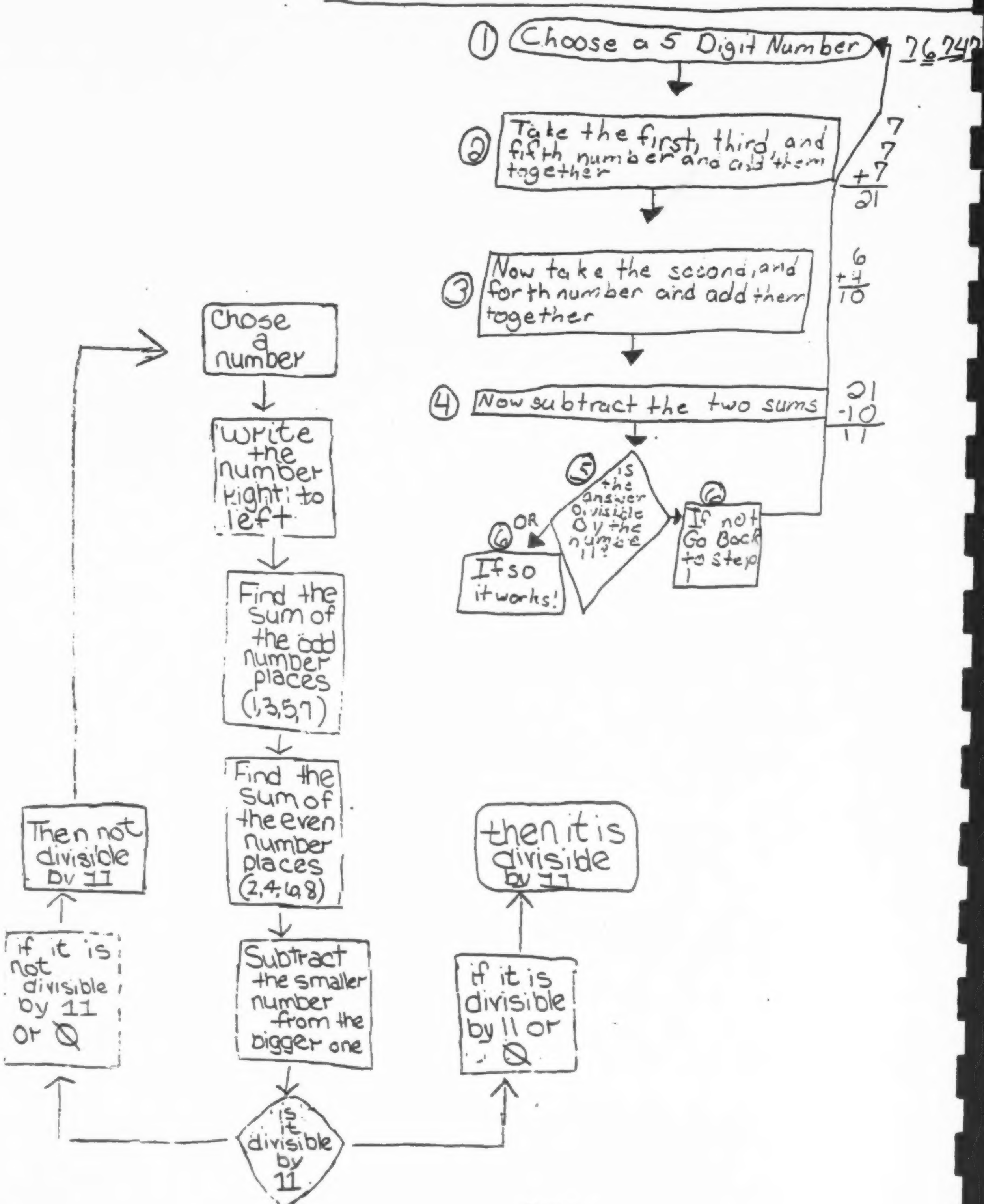

Look at the Last number
Does the number end with 0
Does the rumbered with 5
If so then it is
If not then it is not Divisible
To end! End


Choose a number
Look at the last diget
If it's not 0 or 5 its not div by 5
If it is 0 or 5 its div by 5


Choose a Number
look at the last digit
If it is not a 3 or 6 then it isnt divisible by 6
If it is 3 or 6 then it is divisible by 6
next add the digits

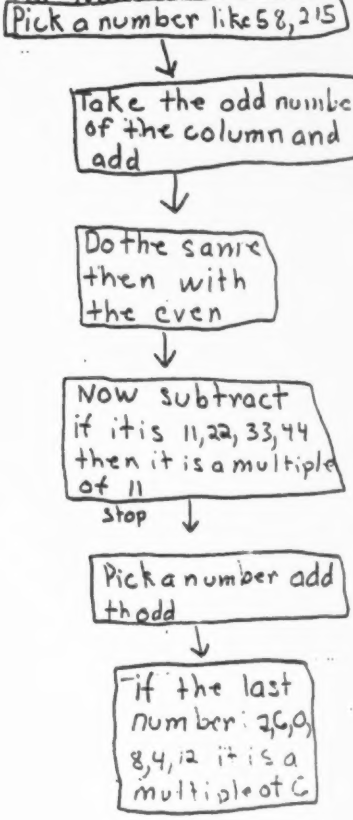

Choose number
Multiply by 11
add 11
is it divisible by 11?
Add one more to original number. Then divide #4 by it.
is it the same as the original number?
Stop

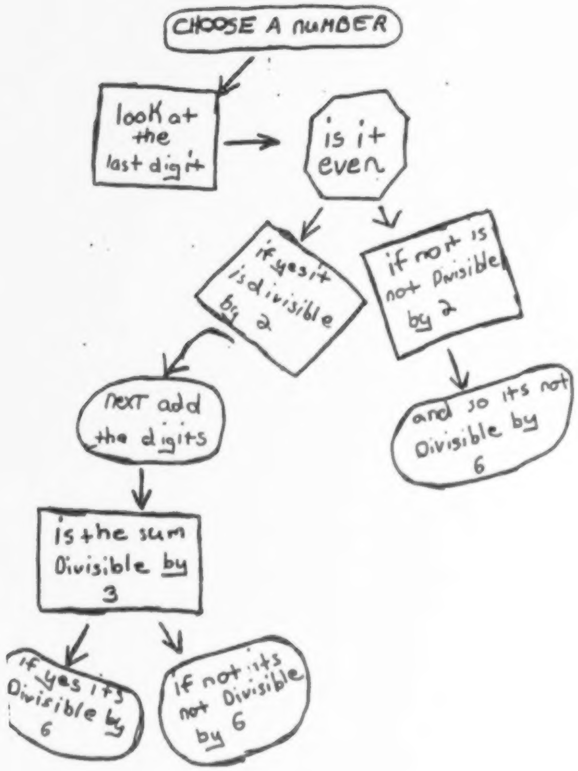
FLOW CHART For NUMBER 1



① Choose a 5 Digit Number
76,74
② Take the first, third and fifth number and add them together
7
7
+7
21
③ Now take the second, and forth number and add them together
6
+4
10
④ Now subtract the two sums
21
-10
11
⑤ Is the answer divisible by the number 11?
OR
⑥ If so it works!
⑥ If not Go Back to step 1
Chose a number
Write the number right to left
Find the sum of the odd number places (1,3,5,7)
Find the sum of the even number places (2,4,6,8)
Subtract the smaller number from the bigger one
Is it divisible by 11
If it is not divisible by 11 or 0
Then not divisible by 11
If it is divisible by 11 or 0
then it is divisible by 11

For Number 11 and 6

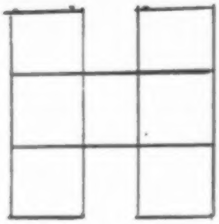

Pick a number like 58,215
Take the odd number of the column and add
Do the same then with the even
Now subtract if it is 11,22,33,44 then it is a multiple of 11
stop
Pick a number add th odd
if the last number: 2,6,0, 8,4,12 it is a multiple of 6


CHOOSE A NUMBER
look at the last digit
is it even
if yes it is divisible by 2
if not is not Divisible by 2
next add the digits
and so its not Divisible by 6
is the sum Divisible by 3
if yes its Divisible by 6
if not its not Divisible by 6

PROBLEM SOLVING -- The "H" PROBLEM

Lisa Cranfill

Use the numbers 1 through 7 to fill the boxes so that the two stems and the bar of the H all total the same. This is the now famous "H Problem" which was introduced to us by Professor I. Weinzweig, Mathematics Department, University of Illinois at Chicage Circle at a Teachers' Center session some time ago. Articles on the "H Problem" appear as well in previous issues of SEEDBED and future articles are anticipated. Can you solve it? What can you learn about children when THEY solve it?



The first thing I did when I tackled this problem was to go on "random-mode" and begin just putting down numbers and adding them using no particular strategy. This didn't obtain the desired results, so I became more organized, listing number combinations on paper. (I have a very concrete brain when it comes to math and need to see the numbers.) I listed the combinations as follows:

1+2+3=6
1+2+4=7
1+2+5=8
1+2+6=9
1+2+7=10
2+3+4=9
2+3+5=10
2+3+6=11
2+3+7=12
1+6+7=14

1+3+4=8
1+3+5=9
1+3+6=10
1+3+7=11
1+4+5=10
1+4+6=11
1+4+7=12
1+5+6=12
1+5+7=13

2+4+5=11
2+4+6=12
2+4+7=13
2+5+6=13
2+5+7=14
3+4+5=11
3+5+6=14
3+5+7=15
3+6+7=16

4+5+6=15
4+5+7=16
5+6+7=18
4+6+7=17

I eliminated the totals of 18, 17, 16 and 15 on the grounds that there weren't enough combinations of those totals. I decided that I needed three combinations of numbers and only two of those numbers could repeat themselves. You must have 3 combinations of numbers, 3 in each, totalling 9, but there are only 7 spaces in the H and likewise use one of each numbers 1-7. I used the totals of the combinations I'd listed moving the numbers within the combinations as needed. I next tried the combinations of 14, but that proved impossible, so I went to 13 and there I found 2 different solutions:

3		1
4	2	7
6		5

and

3		1
6	2	5
4		7

Next, I tried 12, using the same method, and again found 2 solutions:

2		1
3	4	5
7		6

and

3		1
2	4	6
7		5

Next 11:

4		1
2	6	3
5		7

and

2		3
4	6	1
5		7

I tried 10 next, but it didn't work. Since there were 4 different combinations for both 10 and 14, neither of which worked. I concluded that there must be at least 5 different combinations for a total in order to complete the H.

In a different language si gumba means "not very sweet," ja lo means "not brown," and ba ja gumba means "very brown coffee." How would you say "sweet coffee" in this language?

a. lo gumba *b. ja gumba*
c. ba si *d. gumba ba*
e. ja si

APPLES, LEMONS AND HATS
Joyce Bishop

Reading and discussions had turned up two problems requiring that the solver pull together related facts and infer the solution. I had access to a group of nine first graders, and obtained permission to try the following activities:

I) Use three hats, two white and one colored. Arrange two or three students, one behind the other. With their eyes closed, place one hat on each student's head. When they open their eyes, ask first the rearmost student and then the other(s) to tell what color hat is on his head. Try different combinations and see what happens. (Thomas C. O'Brien in "New Goals for Mathematics Education")

2) Distribute six pieces of fruit among 3 bags such that each bag contains 2 pieces of fruit. They are labeled AA (two apples), LL (two lemons), and AL (one apple, one lemon). Each bag is mislabeled--no bag contains what the label says it contains. Ask students how you could reach in ONE BAG, pull one ONE piece of fruit (no peeking) and tell for sure what is in each bag? (Lois Daesch, the Three Bag Problem, SEEDBED #2)

The hat problem seemed to me to require fewer inferences linked together, so we would try that one first. Would the children see any connection between the two problems, and would the first one make the second easier?

<----	white	red
	Amanda	Shelby

(The arrow denotes the direction the children were facing.)

I surely learned the most on this one because I left the extra hat in plain sight! Shelby was quite confident she had the red hat because she could see both the white ones. After Shelby's statement, Amanda knew she had a white hat.

<----	white	white
	Sarah	Becky

Becky guessed she had a red hat, but without much confidence. I asked how she knew, and she was silent, with a perplexed look on her face. Sarah also guessed red, but without confidence. In this case, it was not possible to know for sure. The girls didn't know what color they wore,but they had not mastered this problem to the point where they could say an answer was impossible.

<----	white	red	white
	Teresa	Michele	Luke

An onlooker, Stacy, commented "He knows what color he has," and indeed he did. Luke said "white," but could not give an explanation. Michele blurted out "Red, because Luke said white and Teresa's white." Until then, Teresa didn't know what color she had, and had no chance to think it out. She would have needed at least Michele's answers to know hers.

(From here, the shortest vertical line will denote the first response.)

<---- white white red
"Red."
"White."
Why? "I forgot why."
Why?: "I don't know."

I think they performed the appropriate reasoning, but were not able to describe it.

Then I changed the approach a little. When they opened their eyes, I asked, "If you think you know what color your hat is, hold up your hand."

<---- red white white
3 hand up.
"Red."
Why?
"Because."
"White."
Why: "Because
Luke's is red
and mine has
to be white."
"White"

<---- white white red
"Red.
I can tell
by the feel."
"Red.
Because those
2 have white."
"White. Because those two saw red."

<---- white red white
Hand goes up
I say "I see just one hand because only one person can be sure." Then two more hands go up
<--"White?"
Do you
know why?
"I think I
know what the
paper feels
like."
"Red."
Why?
"Hmmmmm,
"I Don't know."
"White. I saw
the others.

Few of the children could articulate their reasoning steps, but several could come up with an appropriate reason. I saw no evidence that any of them could make use of an "I don't know" answer from the person behind them. I was gratified when one boy said. "I like this kind of problem."

Next, I presented the Three Bag problem. After an explanation, Shelby said I should draw from the AA bag. I asked "What does it mean if I draw an apple?"

Shelby: "That there's an apple in it."

Michele said to try the LL bag. I asked "What if I draw an apple?"

Michele: "It can be an AA or AL."

Becky wanted to try the AL bag. My question: "If it's not AL, what two things could it be?"

Sarah: "AA or LL."

If I get an apple from AL, what would you predict?

Jennifer, with many stumbles over her tongue, said, "AA is LL, AL is AA, and LL is AL." She seemed to have puzzled it out.

If the AL yields an apple, it can't be AL, so it must be AA. We have bags AA and LL left, and contents AL and LL. None of the bags are labeled correctly, so the lemons must be in AA, and that leaves bag LL with an apple and a lemon.

Time was running out, so I reached into the AL bag, and drew out a fat yellow lemon. I asked, "What is this bag, really, then?"

Stacy: "AL must be LL."

I went to the chalkboard to write down some ideas for the other two bags.

Jennifer suggested that AA was AL and LL was AA.

Shelby thought that AA was AA, and LL was really AL. She had forgotten the original condition that all the bags are labeled incorrectly. By now, many of the kids were totally out of touch with the problem, but I regained their attention when I began to open the bags. It was as Stacy and Jennifer predicted: AL was really LL, AA was really AL, and LL was really AA.

This was a group of children who all scored at the 95th percentile or better on their kindergarten achievement tests. Most seemed to have a grasp of the hat problem. However, between the two problems, we made a room change, and after that I lost the attention of some of them. With frequent pauses for me to jot down notes, it was hard to keep the momentum. I have to say that some were never really engaged in the second problem.

However, Stacy at least grasped the idea that the bags were labeled incorrectly, and if the bag we peeked in was not AL, then finding a lemon meant that it had to be LL. Jennifer was able to follow the logic through to name the other bags, and did so, not once but twice.

Did the children perceive any similarities between the two problems, or did the first have any effect on their treatment of the second? I saw and heard nothing that would suggest either, but the processes involved are subtle, and the children are not yet articulate enough to necessarily produce any visible evidence.

CONFESSION OF AN EDUCATION MAJOR

Linda Kumke

It makes me feel terrific to be going into education. In its true light, it's an unselfish profession deserving of much praise and recognition. It is too bad that that praise and recognition is so seldom seen by the average person.

Being an education major, I learn new things all the time about how to "teach" and how to "manage" a classroom - most of which I now want to pitch out the nearest window.

In practice teaching and observing I've seen and spoken with many teachers of different calibre and quality. All of the teachers have stories to relate and plans on how to control and keep on top. Most of these sure-cure plans, I have found, are not so great.

One teacher told me he had a great class - most of them were A and B students, but, of course, there were always a few bad eggs in every dozen. He proceeded to tell me why some of the eggs end up rotten. Many come from broken homes, others are simply lazy, some just don't care. Naturally, the way to take care of these "hopeless" kids is to give them even more grief at school! At least that's the idea I got from this teacher. What I found to be interesting was that he never said these kids needed to be motivated more and he tried to do that. He wasn't about to get involved or try to help. Best leave it alone, I guess.

Another problem I have had is I easily fall into sticky webs. I see a way of teaching that looks like it might work well. I try it, and then find out from a better source I'm doing more harm than good for the student. For example, when I was a child I learned all the contemporary ways of doing everything. I diagramed sentences until I was blue in the face; I studied multiplication tables until I dreamt about them at night. I knew I had to memorize things or else I'd fail. And heaven forbid I should ever count on my fingers!!

Of course I found ways of hiding the fact I was using my fingers. Or, I'd use other props, which seemed acceptable. Now that I think of it though, why should props - lines, circles, peanuts - be any better than fingers? Fingers are tidy, compact, easy-to-use, and go everywhere you go.

But my confession is, I thought using your fingers must be hazardous to your brain. Therefore, whenever I would tutor a child, I would not allow him/her to use their fingers. I would even go so far as to hold their hands when they were trying to figure out the problem at hand. It never dawned on me that they had ways of using their fingers without letting me know about it.

So there's my confession. I feel terrible, but I also think I will make a better teacher for having gone through that. I just feel bad for the poor children who had to bear with me while I was still stumbling. But, when you think about it, my students, like other teachers' students, will have to go through the learning process with me. We will experiment together until we find a way to teach and learn that will benefit all involved.

YOUNG CHILDREN AND GAMES

Beth Weisenstein

After observing first grade children already bored with learning, I knew something was missing in the elementary curriculum. They sat at their desks filling out worksheets until their math group was called. Then they filled out their workbook pages of addition problems. The children's excitement and interest in school was being shattered in the first grade! And we wonder why children are hard to motivate in the sixth grade and beyond?

Young children learn when activities are interesting and fun. Games provide one means of learning. Through games children are allowed the chance to discover an idea rather than being taught it. When children manipulate and experiment on their own thinking, school work often blossoms.

Some time ago, I gave the first grade children some manipulative games to discover math. A fall theme was used since it was late October. Three of the games are as follows:

1. I drew a tree and gave a copy to each child. We collected leaves and each child received 10. I gave the children story problems such as: If seven leaves fell off the tree, how many would remain? The children let the leaves fall and counted what was left.

2. I drew Snoopy dressed as a pilgrim. Each child received 10 turkey drumsticks. Snoopy would eat so many and the children would count the rest.

3. I set up a store with items costing 1 to 10 cents. The children figured out how many combinations of items they could buy for the ten cents they had.

Children can create their own story problems for various situations. They enjoy learning math when they are active in the process and can see relationships.

Double Six Domimo Circle
Linda Carroll

Two teams of five children each. Second graders, ages 6 & 7.

Instructions:

Make a full, connecting circle using all the dominoes, starting with "Blank-One". Each half must match the succeeding half until all are used up and the circle is complete. You must work together.

Results:

Time needed for Team A to complete the task was 15 minutes. Comments during the operation:

"I see the next one!"
"No, no, that isn't the same!"
"You can't do it."
"Let's try."
"Mrs. Carroll, this is a Brain-Drain, isn't it?"

At one point, they were stumped. They had four doubles left and could go no further. They thought they were stopped. I asked if there were any two dominoes that one of their doubles could be placed between. That was all the clue they needed; they were off and running. Soon they had successfully completed the circle. At the same time they discovered that each of their doubles would fit in, not one, but three different positions. This really excited them.

Results:

Time needed for Team B was 30 minutes. There was a lot more milling around in this group before they got going. One of the girls wanted to do it by herself, taking a small group of dominoes over to the side. But the others wouldn't let her get away with it.

Comments:

"Rachael, we have to do it together."
"It won't work!" (after working for a few minutes)
"You're not doing it right."
"Look, they have to match - like this."
"It's too hard to do."
"I can do it, I can do it."

After a point, they seemed to give up. I suggested that they could switch any of the Dominoes that they had already placed. They tried it. This opened up enough new possibilities that they could go ahead and finish.

Summary:

Both teams were very pleased with themselves and immediately wanted to start a new game. I can easily see how this type of activity can teach children to brainstorm, to co-operate in a unified effort and really start trying to solve problems.

ESTIMATION STATION
Doris French

Making estimates or "educated" guesses is difficult for primary grade children. When asked how much, how long, etc., the child usually makes a wild guess. The ability to make reasonable estimates can be developed. Skills involved can be discussed. Estimates can be worked on as a group and then children can be given a variety of experiences to use their skills.

One activity I think young children would enjoy would be a monthly estimation challenge at the Estimation Station. Once a month a container of some object can be displayed for about a week. Children should be encouraged to submit an estimate. Containers and objects should vary in shape, size and number each time. Of course, the number should be commensurate with the children's age. Possible objects would be jelly beans, M&M's, marbles, golf tees, beads, blocks (various sizes), and coins.

After each contest, answers would be discussed and children would be encouraged to share how they determined their estimate. THe closest estimates could be awarded a small prize.

So far this year I have conducted two estimation contests for my class at our Estimation Station. Our first challenge was to estimate the number of acorns in a glass container. To help the children, I provided a smaller container full of acorns and told them the number it contained. We discussed how this smaller number could be helpful. The closest estimate was just two away from the actual number. One child said he could have figured out the exact amount by filling a peanut butter jar with acorns and counting them. This idea led to discussing how the different sizes of acorns would affect this count.

Our second estimation challenge was a container of candy corn. Again I provided a second container, smaller than the one to be estimated. My clue to the class was that the smaller container held exactly half as many as the large container (or the large container contained twice as many as the smaller container). We discussed how this clue would be helpful. This time the closest estimate was l5 short of the actual count. I think the smaller object made it more difficult for the children.

Participation has been voluntary, but most of the children are very anxious to take part. I don't let them make their estimates for the first day or two, encouraging them to do some careful thinking first. Only one estimate per child is allowed.

WHAT IS SCHOOL?

Keith Moran

I asked thirty grade school students the question: What is school? Over half the children answered - a place where you have to come and do what the teacher says. This is an alarming statement. If young children feel that education consists of simply carrying out instructions from an authority figure, the results of their work will be limited.

School classrooms must have order, granted, but as teachers, let's not put limits on young minds. The era of instructors' controlling is out. Tests prove teachers that allow children to experiment and draw conclusions on their own develop better reasoning and problem solving capabilities.

Have an open line of communication and allow children to express their thoughts and reasoning to us as experienced people. With us, a new generation of teachers, let's change children's ideas concerning the purpose of school to something like: A place to try new things and learn about the world around us.

In the town of Pottsville, streets with names that begin with a vowel and end with a consonant run north-south. Those which begin with a consonant and end with a vowel run east-west. Others may run either way. If Carter Street is perpendicular to Agnes Street, is it parallel or perpendicular to Sheridan Street which runs north-south?

SEND MORE MONEY -- AND ALL THAT

William A. Ewbank and Dale Lynn Fry
Taylor-Eastbrook Mathematics Project
Upland, Indiana

Do you ever give your children number puzzles to solve? Of course only the brightest will be able to solve them -- and inventing these from scratch is a pursuit only of a certain rare type of genius. Right? Wrong!

We have tried a few cryptarithms ourselves, and had even solved one or two. The fascination of these puzzles is that the arithmetic is so simple. The aim is very straightforward. One day we decided to see what these 11-year olds would make of them.

We showed them a few examples on the board.

$$\begin{array}{r} \text{BABY} \\ \underline{+\text{BLUE}} \\ \text{EYES} \end{array}$$

is one that seemed possible, but we haven't made it into a puzzle yet. Then there is the old favourite

$$\begin{array}{r} \text{SEND} \\ \underline{+\text{MORE}} \\ \text{MONEY.} \end{array}$$

$$\begin{array}{r} \text{I} \\ \underline{+\text{LIKE}} \\ \text{PEPSI} \end{array}$$

looks promising, but proves impossible. No numbers will fit. Next we gave them a nice easy one

$$\begin{array}{r} \text{MOO} \\ \underline{+\text{MOO}} \\ \text{COW.} \end{array}$$

Lastly we showed two that were obviously (we thought) impossible

$$\begin{array}{r} \text{LETS} \\ \underline{+\quad\text{GO}} \\ \text{PANTHERS} \end{array} \quad \text{and} \quad \begin{array}{r} \text{I} \\ \underline{+\text{LOVE}} \\ \text{YOU.} \end{array}$$

Some saw that these were no-go, but not everyone did. Of course we stressed that each cryptarithm must have no more than ten different letters, and that once a letter is assigned a number, all of these letters must have the same number.

Then we started. A great deal of brow-knitting and pencil-chewing went on for ten minutes or so. We had prepared a number investigation (the four 4s) for those who wanted to give up -- but to our surprise no one did. Perhaps they thought cryptarithms were the lesser of the two evils! Soon some results started to come. Inspired by the MOO COW, J.J. came up with

$$\begin{array}{r} \text{ARF} \\ \underline{+\text{ARF}} \\ \text{DOG,} \end{array} \quad (1)$$

and Lori tried

$$\begin{array}{r} \text{RUF} \\ \underline{+\text{RUF}} \\ \text{DOG,} \end{array}$$

but couldn't make her numbers fit. Jennifer (2) and Steve (3) both had

$$\begin{array}{r} \text{BOW} \\ \underline{+\text{WOW}} \\ \text{DOG,} \end{array}$$

but with different solutions. No one realised that 0 could be 9. Lori also wanted to do

$$\begin{array}{r} \text{QUACK} \\ \underline{+\text{QUACK}} \\ \text{DUCK,} \end{array}$$

but hadn't sorted out the place value situation, while Jenny was equally unsuccessful with

$$\begin{array}{r} \text{OINK} \\ \underline{+\text{OINK}} \\ \text{PIG} \end{array} \quad \text{and} \quad \begin{array}{r} \text{MEOW} \\ \underline{+\text{MEOW}} \\ \text{CAT.} \end{array}$$

Those that were successful, about a third of the class, wisely kept to simple puzzles, like Shawn with

$$\begin{array}{r} \text{EAT} \\ \underline{+\text{EAT}} \\ \text{HOG} \end{array} \; (4) \quad \text{and} \quad \begin{array}{r} \text{FAT} \\ \underline{+\text{FAT}} \\ \text{BIG} \end{array} \; (5)$$

(note these are isomorphic, so solutions are interchangeable): Terry with

$$\begin{array}{r} \text{HOW} \\ \underline{+\text{ARE}} \\ \text{YOU} \end{array} \; (6) \quad \text{and} \quad \begin{array}{r} \text{IS} \\ \underline{+\text{HE}} \\ \text{OUT} \end{array} \; (7)$$

Jenny, who failed with her PIG and CAT, tried to do

$$\begin{array}{r} \text{EARTH} \\ \underline{+\text{QUAKE}} \\ \text{SHAKE,} \end{array}$$

but discovered after a while that the H in the ones place had to be zero. And by the same argument the T in the tens place and the R in the hundreds place also had to be zero. Only one letter can be zero, and so this puzzle was a non-starter. It is thinking like this that makes number puzzles of this kind well worth using in school.

Some children seemed to be fascinated by the letters, but to be unable to get off the ground with any numbers. Angie had written on her paper

$$\begin{array}{r} \text{SOFT} \\ \underline{+\text{BABY}} \\ \text{EYES,} \end{array} \qquad \begin{array}{r} \text{LAKE} \\ \underline{+\text{SEA}} \\ \text{WATER,} \end{array} \qquad \begin{array}{r} \text{LOVE} \\ \underline{+\text{LOVE}} \\ \text{KISS,} \end{array} \quad \text{and} \quad \begin{array}{r} \text{MINE} \\ \underline{+\text{HIS}} \\ \text{OURS,} \end{array}$$

with no numbers at all. Most children quickly saw what a "catch phrase" meant. The most obvious failure was assigning different numbers to a single letter. Once this dawns, nearly everyone will, given time, be able to come up with a valid cryptarithm. As it was, the class worked on the puzzles for 75 minutes. Time well spent!

SOLUTIONS (not necessarily unique)

(1) $$\begin{array}{r} 143 \\ \underline{+143} \\ 286 \end{array}$$

(2) $$\begin{array}{r} 503 \\ \underline{+303} \\ 806 \end{array}$$

(3) $$\begin{array}{r} 204 \\ \underline{+404} \\ 608 \end{array}$$

(4) $$\begin{array}{r} 314 \\ \underline{+314} \\ 628 \end{array}$$

(5) $$\begin{array}{r} 413 \\ \underline{+413} \\ 826 \end{array}$$

(6) $$\begin{array}{r} 765 \\ \underline{+203} \\ 968 \end{array}$$

(7) $$\begin{array}{r} 96 \\ \underline{+42} \\ 138 \end{array}$$

WATCHING A CHILD LEARN

Bob Cowles

This article started with a Teachers' Center child-watching activity involving children's perceptions of the changing position of liquid in a bottle. A drawing of six empty bottles placed in different positions was given to the child. The child's task was to color the empty bottles to show their perceptions of the location of the water as the bottle was moved from one position to another.

In testing a seven-year-old, I was surprised that she placed the liquid in the bottom of the bottle regardless of the bottle's position. See Example #l. I had also done this activity with her ten-year-old brother. Later in the day the seven-year-old was looking at her colored bottles and comparing them to her brother's which were quite different. Suddenly she inquired, "Can I do it again?" I assured her that she could but that we would have to do it later. I wanted to insure that her second try on the activity would represent her new perceptions and not just be a copy of her brother's.

A week later we repeated the activity and, indeed, she had modified her perceptions from try I to try 2. (Take a a look at Example #2.) I had said nothing to her about any errors and she was quite pleased with herself, knowing that she had modified her previous misperceptions. (She had compared her first try with this one.)

I wondered to myself what would happen if several weeks passed and we repeated the activity a third time. Would she continue to correct her perceptions based upon her previous experiences? Would she revert back to her earlier representations? Was she learning, constructing a fabric of understanding about the movement of the liquid in the bottle? Would any new learnings transfer to new situatiions? To test these questions, I repeated the activity two weeks later. The results are shown in Example #3. Apparently she was learning and her perceptions were becoming more accurate since each of the six bottles was correctly represented this time. But what about being able to transfer these understandings to a new situation?

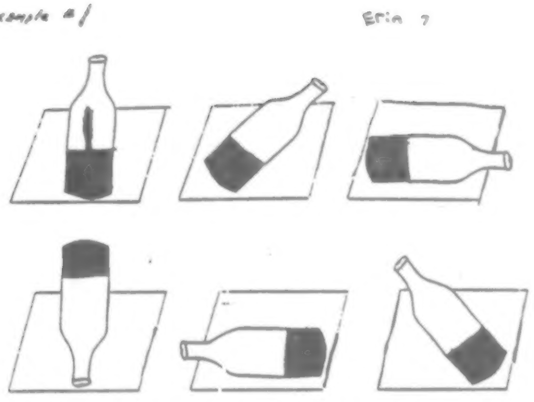
I drew two bottles in two new positions. (See Example #4) Again I instructed her to color the new bottles to look like mine. She carefully examined the bottle I was holding upside down and slanted, looked at her empty bottles, and back to my bottle. Hesitation! "Hum", she said, "This is hard." "Try it," I said, encouraging her. She carefully drew a slanted line across the first bottle which indicated she was perceiving the slope of the liquid. She shaded in the first bottle below the line and proceeded to the second bottle and handed me the paper confidently. While she has accurately observed that the liquid slanted, she failed to perceive the direction of the slant, showing the greater amount of liquid at the top of the bottles.

Had she learned from her previous experiences? Was she applying her previous understandings to this new situation to construct new knowledge? I believe the answer to both questions is yes, even though she failed to represent the new bottles correctly. If, in fact, she had learned from the previous activity, what then went wrong with her thinking on the last two bottles? Let's just say that these bottles are still under construction in her mind. *(Editor's Note: These seem to be by far the most difficult positions.)* In the constructivist view, children learn by modifying old ideas. Perhaps her representation of the new bottles reflect her old ideas about how the liquid looked when the bottle was tilted in the upright position. We must remember that the mind is not a camera. The development of a fabric of knowledge takes time, the opportunity to experiment, and necessitates modifying old beliefs based upon new experiences and understandings.

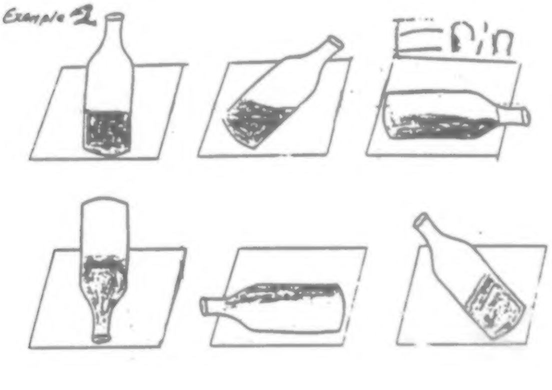
It is also important to make these points. At no time during these activities did I try to correct her mistakes or tell her she was wrong. She learned by experience and observation. Her wrong ideas were modified by her own thinking and learning. Secondly, her sense of confidence in her own ability to think and reason has been strengthened. Had I interfered in her learning as an authority and showed her she was wrong, it would have crushed her initiative and desire to learn for herself. A child's mind is a delicate thing yet the mind can be immensely resourceful.

But what of the unfinished business of her incorrect perception of the last two bottles? We will do the activity again and she will discover, in her own time.

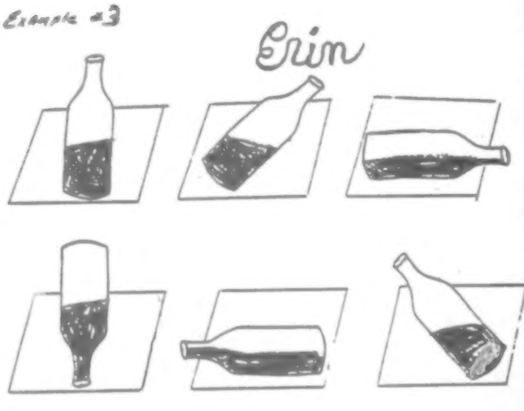
Example #1



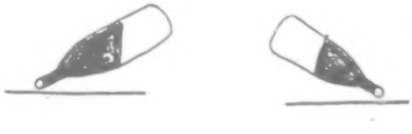
Example 2



Example #3



Example #4



AUTONOMY

Name Withheld by Request

I walked into a first grade classroom to find 23 interactive children. At break time I was bombarded by boys and girls who wanted to read books to me or tell me how to make 20 different paper airplanes that flew great.

Their teacher was soft spoken and warm. She let them play games pertaining to the subject they were working on when they were finished with their seatwork. During math, the children who need Cuisenaire rods automatically got up and got them, no questions asked.

I was informed a little later that this teacher was leaving and another would be replacing her. The next week I met the new teacher. We didn't see eye to eye on things but I kept my mouth shut and watched.

Awful things started happening. The teacher said she needed things more structured! For two weeks I watched her try to make these kids sit in their seat with their feet on the floor and their mouth shut. She piled on the work sheets so there wasn't any free time. Any time they would start to converse she would shout l, 2, 3 with her hand in the air. She wouldn't answer questions and was very stand-offish. Those who needed Cuisenaire rods were scowled at and told to get them if they needed them, like they were dumb or something.

Now for the students' reaction. Five children got sick the first week for no apparent reason. The little girl who came to me reading five books a day was confined to one and the teacher chose it. She was yelled at for reading a library book when she hadn't finished the books the teacher had chosen. Of course her reading diminished to almost nothing. The little boy who made paper airplanes became withdrawn. I couldn't believe it. He just sat at his desk and stared forward. The two slowest boys in the room were yelled at more than ever and this made them even slower. One boy who was at one time friends with everyone was now pushing his friends down and hitting them. The teacher and he were always fighting, almost as if she hated him. He was a good student; he was just bored. Lastly, the whole class was to work on one story in reading for two days because she said they would finish the book too soon and it was too late to start a new one.

I couldn't believe what I was seeing. I watched a basically autonomous classroom fly right out the window. At times I felt like putting bars across the windows because it seemed like a prison. I wanted to help these kids so much but as an observer there was nothing I could do. I learned a lot about autonomous learning from this experience.

A STUDENT'S MONOLOGUE

Jeri Fesler

"Look at Miss Fade sitting at her teacher's desk. She looks so powerful sitting on her chair. Should I ask her to explain fractions to me again? I really do not understand them. But yesterday when I asked her about adding fractions, she yelled at me, "If Krista can understand it, you should be able to also!" Well, I'm not Krista, who is the smartest girl in the class. I am me. Why is she having me do something I'm not able to do? Can't she understand that I don't know what I'm doing? She should be teaching the kids in high school. She just wants to teach the brainy ones. Sure Krista understands it; she knew how to work with fractions two years ago! Why can't Miss Fade teach the rest of the class now? Look at her hair. It looks like she just got a new perm. I saw her talking to the new English teacher. I bet she has a date after school with him. I wish she'd stay after school with me and teach me this stupid stuff so I wouldn't feel so dumb in class. But she doesn't have time. Heck, she doesn't even have time to make up a test for us like Mr. Yete. She just copies the tests out of test books. Last time, even Krista missed over half the questions on the test, but she still got an A "cause of the curve." I hate it when Miss Fade says we are going to use the curve grading. If she didn't use it, even Krista would get an F! The whole class would get an F!! Boy! Mr. Garr, the superintendent, would be so upset with her if that happened! Then maybe he could tell her that she had a lot of people in her class who didn't understand her. Look. She's laughing at Billy 'cause he doesn't understand either. Poor Billy. And look at Krista. She's smiling and looking at Miss Fade. Miss Fade is smiling back. They must think it's funny that they know it and Billy doesn't. Why don't they explain it so Billy knows too? Is it too much trouble?" Maybe they like laughing at us because we don't understand. I wish I understood it. Maybe one of the older girls on my bus will explain it to me. I've just got to know it or I'll flunk this Math class. Maybe I can look it up in the encyclopedia. I can't understand it in this stupid book. Oh! Oh! Miss Fade is looking at me! What will I say?"

"Yes, Miss Fade, I understand it perfectly."

For this problem assume the first two statements are correct.

All bears are butterflies. All bees are bears.

a. Can you be certain that all bees are butterflies?

b. Can you be certain that all butterflies are bees?

DO THEY NEED MORE?

Tracy Mays

As a special education major, I know the problems with children who have special needs. Many times it can be frustrating trying to get through to one of these students. The regular classroom teacher is not trained to deal with this type of student, therefore they send him/her to special education classes. These classes are not always the best answer for the student, but for the teacher.

A student in a special education class is labeled for life. Often this is the only way to give him/her the proper education needed. However, in some cases this is not the best move for the student. Many children need only a different method or a little extra time from the teacher in order to understand a concept. Many teachers do not understand this and only wish to get the student out of their class. This is very unfortunate for the student, because the move to special education is something that sticks for life, as opposed to the teacher, who gets rid of the student and does not worry about them again.

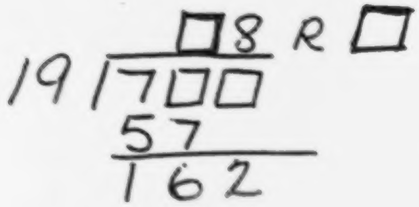
I think elementary teachers should be required to take some special education classes. I know they do have to take one, but it involves mostly technical terms and does not get into the feelings of the students involved. Regular classroom teachers are the ones that refer the students to special education and they should be more aware of the seriousness of that action. Most students, once placed in special education, never get out. Teachers are teachers because they care about children and what happens to them. Some teachers are forgetting about that caring.

I know not all teachers are so quick to judge children, but some are. I know I would never want to think I was the reason for a student being wrongly labeled for life. This is why I am getting a degree in special education and elementary education. I want to know I have tried everything in my power to reach a student before I refer him/her to special education. I do know how important that step is.

DETECTIVE DIVISION
Sharon McCormack

Working with the seventh grade math class on division, I found the students were more interested in solving the problems if only some of the dividend and some of the quotient were given for each.

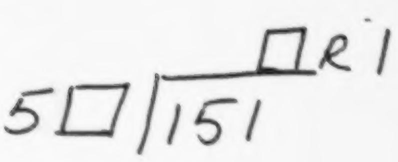
Here's an example:

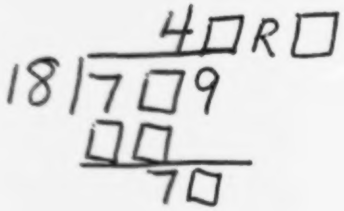


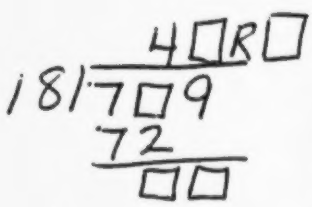
Can you solve it?

After presenting this to the class, students produced problems for each other.

Here are some examples:







The students found that giving certain information was very important. Sometimes the information given limited the student to only one answer. Other times because of the information withheld, more than one answer proved correct.

COMING ALIVE IN SCHOOL MATH AND BEYOND

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The past thirty years have seen increasing efforts in the USA, in fact in much of the world, to make "math" more relevant to school children; the degree to which they fail to learn successfully is gradually being realized. The economic, political and other pressures throughout the world have turned more attention to the problems but also have caused more difficulty in bringing calm and sane solutions. Moreover, there is increasing realization that the difficulties continue into the college years, in calculus for instance. There have been local gains, in some cases getting the children more involved and increasing understanding, and in others raising test scores with little evidence of true growth, but these have not changed the larger picture. There is also a growing body of concerned individuals and groups working in various ways towards better schooling; and in the USA some high level committees are being set up to attack the problem more thoroughly. Hence one should now hope that at last we will see some real change for the better.

It is this I want to promote. But such an intractable problem requires a great and steady commitment, and this is very difficult to give to a subject of such elusive complexity. There have been writings that bring out the essentially simple though deep nature of the problem; we mention three from third world countries, namely D'Ambrosio [1], Nebres [9], and Gerdes [6]. We must continue from such starts.

The roots of the problem lie directly in the mathematics classroom; it is there that the advancement towards maturity is expected. What does this advancement consist of? How does the usual classroom differ from this?

The first question depends on the purposes of learning mathematics. Mathematical reasoning is becoming steadily more important in many domains; hence a basic need is for students to grow in power in such reasoning. In addition, they must gain control over their work, see interrelations with other aspects of the subject, and communicate well with colleagues and others about these matters. Thus:

(l) A primary aim of studying mathematics must be to grow in your own natural reasoning powers, especially in domains where precise reasoning is valid. The growth must include creative and critical thinking, increasing control over one's work, seeing connections with related matters, and raising communication skills. Simply stated, the individual must take increasing responsibility over the work being done.

In the usual classroom, however, the student's focus is elsewhere.

(2) In the usual school mathematics class, the student's aim is to try to remember particular patterns of thought coming from reasoning, but to disregard

Expressed simply, students normally try to remember strings of words and symbols without even considering whether these are saying anything. This is, of course, completely useless in general.

When mathematicians set up curricula, they naturally assume that all work will be carried out with meanings. Why has this gotten so lost in school? Is this not a clear cause of the general failure? Why is all this apparently disregarded by mathematicians and others, even on the highest level? These questions are in great need of answering. Certainly a basic cause of the disaster is the following.

Straight teaching, i.e. presenting the material, has a strong negative influence. It causes the listener's focus to follow your words, your thoughts, not his or her own. Thus, unless the listener has time and freedom to think over what is being said, compare it with what has gone before as well as with his or her own experience in related matters, meanings will get lost or not even arise. In school nearly all is taught, and the time and freedom needed for assimilation are missing.

I have been making strong statements, so it is well to produce evidence of the failure. I recall some examples from the national assessments (NAEP, [8]); there is more discussion in [12].

An exercise given to 9- and l3-year olds was $\begin{array}{r}21\\ \underline{+54}\end{array}$. The success rates were 90% and 98% respectively. In the form "What is the sum of 2l and 54?", the rates were 69% and 91%.

This raises a basic question. Why did those failing the verbal form not simply copy the question into "vertical form" and do the sum? Was it that they could not or possibly did not know this was possible or permitted? But apart from this, if they had been working from meanings; the question would be almost trivial. So whatever the cause, the school experience somehow hinders using your own power to answer questions put in unusual form.

The 9-year olds had l7% success with "Subtract 298 from 313." At that age, can they not simply count from 298 to 300 and add l3? With any sensible practice with mental arithmetic that includes meanings, this is quite trivial. Again, the school experience is clearly at fault.

At the present time there is a growing call for "problem solving". How are the children doing? To the question, how far is it "all the way around" a rectangular garden l0 feet long and 6 feet wide, the majority of both 9- and l3-year olds simply added or multiplied the two numbers. This is quite conclusive evidence of the attitudes of the children: In school, no matter what the question, you just guess what operation to use (perhaps with outside clues to help).

There is no question about it; these children are working without meanings. Their time in math classes is essentially a waste.

What is school math, anyway? Mathematicians might be shocked if they really knew. (A large percent of adults say "I never could do math!" When they come to me, my response may be, the feeling is valid, but for a different reason. You were confused by the fancy math language; you never had a chance to see or do real math, which is easy and fun.)

The first few years of school math, to mathematicians, is the study of the four operations on the natural numbers, mostly restricted to the case that answers have to be natural numbers. This is a very small subject. But to "make it easy" (for those poor children who "can't think"), it is "cut up into tiny bites," in all texts. Thus, for example, subtraction is a myriad of topics: Numbers below ten, one of them above ten..., without borrowing, with, the same with more than two digits but no zeros in the minuend, and on and on. Each has its own set of rules. (Compare [12].) Already, as a consequence of this fragmentation, great numbers of children are put into remedial work, being labelled "disadvantaged," "slow learners," and so on.

I want to illustrate this problem with fractions. For some years you are taught, retaught, and again retaught fractions; the next teacher starts the process over again. Then a "new topic" arises, "mixed numbers," and the teaching begins again, going on interminably. (What is the mixed number? 2 3/4 for instance.) It is all based on a confusion that confounds the children: The fraction two thirds is the shaded part of a rectangle; it also is the shaded part of a pie. (But is a pie a rectangle?) In texts, hence in school, you are never permitted to write 2/3R (R for the whole rectangle); you must write 2/3 only.

I first saw the struggle with mixed numbers in l967 when I attended a 5th grade class, being taught how to do 6 l/4 - 3 2/4 by a "master teacher." (That 2/4 was clearly to make it easier; meanings were not to be seen.) Clearly the children were learning the rules and then forgetting them. For a comparison, I asked a 4th grade girl that afternoon, who had not studied fractions what 6 2/7 - 2 4/7 might be. She answered easily "Take away 2/7, leaves 6; take away another 2/7 leaves 5 5/7; take away 2, leaves 3 5/7." With meanings it becomes obvious; no rules are needed.

In general, we see that school mathematics is commonly taught as a very complex subject. It is replete with cases and subcases, each with its own set of rules, to be drilled into the children. This is like a series of grafts, applied one after another, each one withering and probably dropping off, leaving its bit of poison (math anxiety) behind. And we know that most people (of any age) use their own methods rather than the ways they were taught in school for calculations outside school (compare [3]).

It is as though we have completely lost faith in our children. In spite of their preeminent learning when very young, we expect them (especially the "disadvantaged") to begin to flounder in math in early school years. So we put more pressure on both teachers and children, creating more struggles with rules, discouraging them still more.

I think we are at the worst stage in this regard in US history. Creative thinking requires some reasonable peace of mind. There is little to be had at present. The problem is compounded by the changing points of view on schools and mathematics in the last thirty years; I give a very brief picture of this.

The "new math" was designed to bring a deep and powerful understanding of mathematics through its unifying structure. It was partially accepted on the secondary level, but when it entered the primary level, the clash between theory and practice led to partial chaos. In the meanwhile, behaviorism came charging in; soon the demand was widespread that all school work be processed by behavioral methods. The computer industry joined in, even trying to make all teaching "teacher-proof". The cry "back to basics" began weakly, but by now has swept the country. All these viewpoints are now mixed in a witch's brew, with many varieties being seen in different regions. Perhaps the principal result is simply that varying complex forces are landing even more than before on schools, teachers and students. Moreover, the pressures themselves have had secondary effects in the USA. With financial worries, the states have set up assessment programs to furnish hard data needed for federal funding; along with this, there has arisen a mania for comparison, and ways are being designed to increase the testing so that all states (and schools?) can be put in some order, meaningful or not. Each teacher and each child is now being watched even more closely.

These pressures on the classroom are very strong. We must work to counter them as best we may, and lessen their effect on the actual classroom situation.

A bad blow to the great mass of students who are in difficulty in mathematics was given by the dissemination of the report "A Nation at Risk" [10]. It called for more monitoring of students by teachers, and for more work in mathematics by all students, failing or not; in particular, for longer school days and years, and for "far more homework." This has resulted in the states mandating requirements of this nature, or moving in that direction. The direct effect on the failing high school students, who have no idea of what the math is all about, is, of course, to drive them into further crisis.

I want to speak especially about the indirect effect on the teaching-learning problem. An eight second excerpt of talk that is normal from a teacher will illustrate this. "Alfred, what do you do next here?" (One second of silence.) "Edith?" (Another second of silence.) "All right. Children, here are twelve exercises for tomorrow."

What do we see? The teacher is monitoring the children, as many as possible each period; this is expected and now demanded. So only the briefest possible pause can be made for any answers. Then, to be certain that they work hard (for that is supposed to produce learning, if kept up long enough), many homework problems are assigned.

And what is the effect on the children? There are several effects. First, the children are still further strained and unhappy, on the verge of giving up. Next, they more completely restrict attempts at answering to repeating words of the teacher, and do a larger percent of the homework problems simply by guesswork. But, more insidious, they are trained more rigorously to think the barest minimum about anything pertaining to school work. It is "half-think before you speak" (or write).

Thus pressures in general, in school math in particular, are helping produce a generation of half-thinkers. And since the basic requirement is to get the teacher's thoughts, not your own, your thinking is about what is wanted from you, not what you can come up with yourself.

The body of the report quoted begins as follows. "Our Nation is at risk. Our once unchallenged preeminence in commerce, industry, science, and technological innovation is being overtaken by competitors throughout the world." The principal effect of the report is almost certain to be a further restriction of students' growth, leading to further decline in creativity.

The concept "work harder so you learn more so our nation grows" is a prime example of half-think. But we all half-think in much of our life; I find myself doing it at times, though less than before.

I have spent too much time discussing negative aspects of schooling. Why not jump right into the fine work? All right, let's pick a "hard" topic, say those fractions we were talking about.

Here is a candy bar (a long thin rectangle) that three girls want to share. How can they find where to cut it? With freedom to explore, they will try many ways. Soon, for such a purpose, they will be using marks on a piece of paper they will move around. The ruler has been reinvented!

They have found a certain length a bit too short for that candy bar; they want to stretch it. Make it of rubber! Acting on this, they take a rubber band, and to make even marks on it, stretch it over lined paper. Now they stretch it over the candy bar. It won't stretch enough; the marks are too close together. But with more play, they see that they can make six equal intervals; each girl can have two! They see, in our notation, that 2/6 = 1/3 and 4/6 = 2/3. They understand what we call "equivalent fractions," which are seldom understood in a real sense in school.

With more play, they want to find a third of 10 inches. It is a little more than 3 inches. They try holding one mark carefully at the start, and watch two other marks, over 2 and over 6 inches. Stretching, the first mark goes over 3 while the other goes over 9. Oh yes; three threes are nine. Next 4 and 12 will pair off; but we want 10. Since 10 is a third of the way from 9 to 12, we must go a third of the way from 3 to 4 with the other mark. So it is a 3 1/3 inches. Joy in the group at how this was discovered!

Becoming experts, they start dividing 100 centimeters into parts. Halves and quarters come out nicely, just like dividing a dollar. Thirds are funny again, but nice. Half of 25 is twelve and a half; so adding this to quarters gives eighths.

Aunt Katie sees them playing, and tries them out. "Show where these fractions are." She picks on

$$\frac{5}{8} \quad \frac{3}{10} \quad \frac{3}{5} \quad \frac{1}{4} \quad \frac{2}{3} \quad \frac{1}{2}$$

"They're too easy!" the girls remark, showing quickly where they are.

We remark that in the NAEP, all three age groups (9, 13, 17) were asked to put these fractions in order of size. The percent of correct responses were 0%, 2%, and 12%, respectively.

The story I have presented is not just fancy; it represents a mixture of ways I have seen plenty of children play and explore.

"But this could never happen in a regular classroom!" You cannot prove that. On the contrary, there have been numerous classrooms where, with freedom, nice-looking things have happened. I mention especially the experiment of Benezet, Superintendent of Schools in Manchester, New Hampshire, in the late twenties to mid thirties. He saw children held back because of failure in arithmetic, and with poor language skills in all grades. So in experimental classes, he suggested free discussions to promote language skills, and for arithmetic, estimating and then measuring lengths, etc. All formal arithmetic was cut out through Grade 5. These classes came alive quickly. Moreover, the children (mostly immigrant) surpassed the regular classes in both English and arithmetical reasoning. Benezet's report [2] is beautiful reading and inspirational. And what teacher training did he use? A few conversations with the teachers, that was all.

We have seen the havoc wrought in elementary school by the disregard of the children's poor experience. Under Benezet, not until sixth grade did the children start formal arithmetic; yet they caught up to the others in that year (and remained far above in mathematical problem solving). We are beginning to recognize a similar kind, if lesser amount, of failure in calculus classes. We know the learning is apt to be mostly by rote, and the students have to be taught how to put it to use. Moreover, if you ask them in a quiz to say what a derivative is, you know you will get mostly nonsense. This, however, is equally a failure to reach an ease in expressing ideas of any complexity in English. Most students have never had real practice in either saying or writing ideas beyond the simplest. The half-thought has never grown into thought-succession. The free discussion promoted by Benezet resulted in growth in this direction. Ability to explain in simple language the difference in size between two fractions with the same numerator was a particular test case he used; I recommend trying it widely.

Replacing lecturing by exploration on all levels is equally valid. In subtracting 18 from 42, "borrow one from the four" is a mumbo-jumbo to most children in differentiating $\sqrt{x}$, "multiply above and below by $\sqrt{x+\Delta x}+\sqrt{x}$" is of the same character.

On the other hand, making 42 - 18 real with materials and letting the children work out what this is takes a lot more time at the moment, but results in an understanding never reached by most children; see [12]. And in looking for an example (corresponding to materials) of $y = \sqrt{x}$, we may choose the side length and area of a square. Letting students play with this, they see meanings of Δy and Δx, and can work out the relation between them. Finding meanings to the expressions is the crux of the matter (see below).

I want to talk next about some questionable practices of mathematicians, some of which make real problems in education. My purpose is not to list mistakes but to show areas where one can easily be careless.

When the new math was brought into the elementary school, naturally the elements were presented, like the commutative law for addition. But no one asked, the law for what system? The mathematicians knew the plus sign as something with two prongs, the first and the second. But children know of sets of things as being put anywhere; there is no order. Moreover, the kindergarten workbooks made use of this in showing the children sets and pairs of sets in any position for counting. Thus the children were taught the commutative law, and could make nothing of it, in part because there were no ordered pairs in their experience. How can we go on for years, seeing children looking blank, and not even see the contradictions we are presenting to them?

The effects were much worse with expressions like $\square - 7 = 4$, which of course children cannot decipher. So teachers were forced to explain "The equal sign means..." which is pure gibberish to the children. A sign does not have meaning. Also the children know that seeing $3 + 5$ is a command to do something; so saying it is a name for a number is like saying that "put this book beside that book" is a name for a book.

Most mathematicians would not define a "variable". On the other hand, they do not object when others do, and their children are taught it; hence this is taken as assent by the mathematical world to doing this. If an algebra student should ask "I know how to multiply a number by a number; but how do you multiply by a letter that stands for...?", there could be no answer that makes sense.

The word "equation" is used in many ways, often informally, so it also cannot be defined. Any time an equal sign is written, it should be made clear to the reader what is intended: a statement, a question, something to look at, or whatever it may be (if the writer knows). Students have quite universal problems with meanings in algebra, and rightfully so, when the texts write equations as though they had meanings in themselves (and some professionals believe this).

This is a basic part of why algebra is a subject which stumps large numbers of students; and it is not their fault. I think it is the worst subject in school and college mathematics in this regard.

Discussions on curriculum and similar matters are pointless when the relation to the students is disregarded. For instance, a common view presented by mathematicians is "fractions are too hard for the students, and they are less important now with calculators, so cut most of it out of school". This is mistaken in that the children are not working with fractions; they are working with supposed sets of rules, which seem to be different on different days; thus the mathematician's comments do not apply. Also fractions are important, inspiring and easy, as we saw above.

Finally "What can we take out to make room for more material: makes no sense when nearly the whole of the children's' time in math classes is a waste. You get all the time you wish by dropping the present teaching. (And recall that Benezet did just this.)

The discussion above I believe is quite relevant to research in mathematics education. In this country, the research is generally carried out in a classroom situation, for instance by studying different teaching methods. But when most children are looking only for the rules of the moment or guessing which operation to use, the teaching in the usual sense has nothing to do with it. Moreover, the children do sets of problems quite commonly in a haphazard manner, thinking a bit on some and not on others; taking statistics here is very unlikely to be meaningful.

The case studies now being undertaken make much more sense. Yet I do not think it is sufficiently realized that getting in touch with the student in a more complete way is important if the student's hidden powers are to be unearthed. The attitudes, especially to give back what she or he thinks is supposed to be given, is very strong, and will only slacken if real acceptance of the student is felt and trying new attitudes seems all right to the student. For this to work, real two-way communication is needed. If all questions come from the interviewer for instance, this is not really getting in touch. Informal sessions over days would normally give sufficient thinking time. Here is an example where the difficulties arise.

The "students and professors problem" [4] is: "Write an equation for the following statement: 'There are six times as many students as professors at this university.' Use S for the number of students and P for the number of professors." The immediate request "write an equation" is quite upsetting. Few students have a real sense of meanings and use of equations, as mentioned above; here, there is no obvious use, so meanings are hard to come by, and seem artificial. Hence "write an equation" is naturally reduced to "put in an equal sign," and $6S = P$ appears. Also, please try using NS and NP or NS and NP in place of S and P; the improvement may be tremendous.

There is a large and very important field awaiting the researchers: What are students capable of if given the chance to explore situations? We badly need to show their powers; you can help!

There is still a basic question that I want to raise with the mathematical community. Are we properly considering not only students, but the professions, even our own? We are not fully appreciated; there are real reasons for this. We can close ourselves off, deep in research. This is fine, if we wish to stay there. But students have not yet the maturity for this, nor is it safe for them when a lasting future is not yet there.

In both school and university, a deeper responsibility to them would be to help them mature and grow in their own responsibility. We work hard, we read and correct great numbers of papers. While we are serving them, we are also disserving them and ourselves. Our message is, truth comes only from us, so they cannot be secure in knowledge, and are held hostage to our approval. Throughout education, there is a far better method. Let them hand in only careful work. Grades can come from such work; no work will be marked against them. Solidity of knowledge is shown through self-tests (see [11] and [12]); with this accomplished, they can say properly "I have it," and pass to the next topic (returning to the former if and when needed). This is to everyone's gain.

How about the actual teaching process; does it work better in college than in school? Of course by this time the students are supposed to be well prepared to think through and assimilate material being presented (if this is carefully done, with sufficient pauses and discussion). But very few college students have reached this maturity, so under lecturing, they continue getting the pattern but not the subject matter and reasoning behind it. Again they are working under teacher-power, not own-power. They learn the rule for differentiating $\sqrt{x}$, and some could reproduce the proof, but they have only vague ideas about meanings (in spite of all the talk we offered them).

I was asked by a group of South American science educators "What do you do when they understand $y = ax + b$, but not $x = x0 + vt$?" Of course "understand" means, know certain things you do, like "find where it cuts the x-axis." But they may not know even this, if they learned it with "m" instead of "a".

"But then they shouldn't be taking this course!" is a natural answer. I respond to this by telling about Beth, who has had very little math but plenty of math anxiety all her life. I said to her last year, "Beth, the youngest children in a family want to talk about 2, 3, 4 dollars, the next ones about 30 or 40 dollars... Let us put 1 here and a million there (at opposite ends of the counter). What are some numbers you can put in between, to give each group a good space which they can see and compare with upper spaces?"

After some playing with it, she showed (pointing) 1, 10, 100,....., spaced evenly. Then she tried placing 2, 3,....., 9, shortening intervals while approaching 10. But seeing 100 ahead, 11 has to be quite close to 10, so she pulled 9 up closer. (In our terms, she wanted the first derivative to be continuous.) Soon she chose a better place for 2 after 1, and at once placed 20 the same distance after 10. At that point I exclaimed that she was constructing the exponential function and finding its derivative!

Then I realized that during twenty years of teaching calculus, very few of my students had the real feeling for these concepts that Beth had brought out for herself. My recent (small) experience is that most adults, asked what I asked Beth, and irrespective of their knowledge, would proceed in similar ways to Beth (who had done it all in about 20 minutes). Benezet cut out formal math teaching through grade 5; it could well be cut out through high school, as I see it. (I do not suggest this as a solution to our problems.)

Perhaps the most important point is that if you let the natural human powers come to the fore, with all the interconnections between widely dispersed elements, you can do great things. Beth's mind had gone in part to young children's thoughts about pennies and dimes, and how the line she was thinking of would be copper at first, move into silver, and so on. In a whole structure, things tie together, become real and meaningful, and relate to further domains. Our cutting off all extraneous matters from "pure mathematics" leaves it bare, devoid of anything that can be grasped by minds not yet used to such abstraction.

An example of an exploration that would be natural in a fine learning environment is the following. A square has side length s and area A. Suppose it gets a bit bigger; the length increases by Δs and the area by ΔA. How do these compare? Playing with this, one may put one square on the other, a corner of one on a corner of the other, and see an extra band going around two sides; one sees its area A, equal to $2s\Delta s + (\Delta s)2$. With small Δs we have approximately $\Delta A = 2s\Delta s$.

The next stage is to show this in various ways; this leads to a better understanding of the notion of a function and its inverse and the relation between the two derivatives. The important point here is that the understanding of the situation comes first, and properties of the situation are well grasped; notation and language about it, with plenty of student discussion, follows. The symbolic expression is not interpreted, leading back to the understanding, and the whole becomes student-controlled. Note the correct order of learning, with the symbols and 'concepts' at the end instead of at the beginning.

Mathematics, as a subject in itself, is at the highest point in history. In recent decades the interconnections discovered between algebra, analysis and geometry are steadily expanding, and this, with the emergence of new fields, has brought about increasing applications in various subjects, including mathematics itself.

On the other hand, our world has a human population, and mathematics affects these humans in many ways. For best progress, the mathematics must reach them in a positive way. This applies in particular to those who are studying math in schools, colleges and universities. Here the picture is very different. Mathematics is a very important service subject for those entering scientific fields (including mathematics itself). Calculus in college plays a central role here, and we know how masses of students are failing to grasp the essence of the subject; the majority are dropping out, or are unable to use it in applications without being told explicitly what to do. This is not the fault of either the subject or the students (see the happening with Beth described above). It is inherent in the continual teaching of all math, from early grades on, as we have seen. This is beginning to be realized more, which tends to place blame on the professors and their method of teaching. Along with this, math itself is getting an increasingly bad name.

Rectifying this will be a large order. To start, we must show a fuller concern for students. The common policy of top universities, "research first, do something for the students too," is taking on elements of a disaster for the departments of mathematics and the universities themselves.

In the USA, there are moves to bring these problems to light and attack them in a basic way; this is extremely important. The same difficulties appear all over the world, on all levels; moves to work together for improvement are under way here also.

The actual improvement must of course be in the classes. But how? The essential point is to give the students situations to explore; then classroom discussion of what is happening and being discovered (or not) becomes growth in exploration and discovery. That this method can work wonders is seen by examples, for instance Beth's experience. It takes careful thought, cooperation and time to get this working well.

It is true that if we try at once for a real shift in teaching towards explorations, there will be found a solid barrier towards such change. But this is because we wanted an immediate solution, without regard to those concerned with the present teaching.

One must find practical ways to move toward reform, leaving most of the present teaching unchanged (at least at the start). Not only the students but also the professors and others must be considered.

We push the students to make them learn; it does not work. Pushing the professors to teach differently will also fail. Pressures have too much that is negative. We need positive ways; and these must grow by themselves, not be forced. Humans grow through care and love during long periods; the same is true throughout nature.

As little sprouts rise from the ground, gentle nourishment and care will let them gain a hold among the weeds. Forcing them up faster will kill them. As they spread and grow taller, let all the plants live quietly together. If the weeds are pushed away or cut, they will land on the flowering sprouts, and again we have death. But with the whole family living in peace, some weeds will finish their time while others start flowering, and a living earth will come to be.

Following such principles in our work will help reduce confrontation, replacing it by improved and more open communication and cooperation. This can lead to better schools and colleges, a better land, a saner population, and perhaps the saving of humanity from still worse disasters.

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A TOUCH OF AUTONOMY

LaVonne Timmins

A couple of months ago, while I was on playground duty, I noticed my fourth graders lined up against the side of the building. As I walked up to them I noticed they were playing some sort of game, in a "game show" manner. After recess I asked one of the participants what game they were playing. She told me it was their version of Trivial Pursuit. The teacher overheard this statement and explained the students had adapted the board game into a game show format with a host, contestants, judges, etc. He also noted that they had come up with the idea on their own. They decided amongst themselves the rules, the questions, who would play when, etc. He also emphasized that he had kept totally out of the planning and the students handled any disagreements quite well on their own. He felt it had been a good learning experience for them. They learned organizational skills, and how to cooperate and communicate with each other. In addition, they were learning science, math, spelling, English, sports and television facts.

Dracula hates daylight more that Wolfman unless Frankenstein hates daylight more than Dracula. In that case Wolfman hates daylight more than Dracula but less than Mummy. Mummy hates daylight more than Dracula but less than Frankenstein. Show a diagram of the monsters ordered according to their hatred of daylight.

P.F.B.

Judy Klopher

The following is an enjoyable math game that makes thinking fun. It is called P.F.B. One person decides upon a number. The size of the number depends upon the skills of the group. The leader puts blanks on the board for each place value in the number.

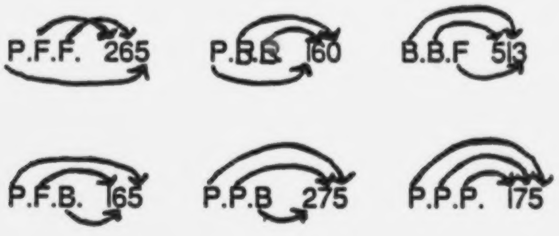
For example, my number is 175. I would put ___ ___ ___ on the board. Then you would take turns guessing 3 digit numbers.

P = the right number in the right place (perfect/place).

B = a right number but not in the right place.

F = nothing right (flunk).

If someone were to guess the following numbers, I would make them in the manner below.



You continue guessing numbers until someone gives the right number.

(Editor's Note: This activity is widely available on public domain computer diskettes, sometimes under the name Disc-Fun. To have seventh or eighth graders program the game (or similar games) is a challenging and worthwhile activity.)

SUBTRACTION SUCCESS
Stephanie Richie

I had been doing observation work in an LD classroom for about three months. An eleven-year-old in the class could not do a subtraction problem. She was very frustrated because, if she did not know how to do this by the end of the school year, she would not be able to go to junior high. I told her I had learned a way to teach subtraction without saying "we borrow a ten from the ten's column and add it to the one's column..." At first, she found it difficult to forget the way she had been taught, but she started seeing it as a game and thought it was fun.

We started with a subtraction problem like $\begin{array}{r}36\\ \underline{-9}\end{array}$. I asked her if she could take 9 away from 6 and she answered no. I told her since we couldn't do that we take 1 away from 3 $\begin{array}{r}2\cancel{3}6\\ \underline{(-9)}\end{array}$. Here's where the game comes in -- "If I have 10 pieces of candy (could use anything the child likes) in my hand and take 9 away, how many will I have left?" She said, "One." {Note: When I asked her about the candy, I cupped my hands together so she could visualize it.} So, now our problem looked like this: $\begin{array}{r}2\cancel{3}\boxed{\overset{1}{6}}\\ \underline{-\cancel{9}}\end{array}$ with the one above the 6 from the candy question. I circled the $\boxed{\overset{1}{6}}$ and told her to add the two numbers and bring down the 2. So, our answer was 27. After doing a few problems together, I had her do it. She was asking herself the candy question and cupping her hands like I had done. She must have done at least thirty problems in a half hour. I had never seen her so excited about math. The teacher was going to let her teach other children in the class who were having the same difficulty. When I left at the end of the day, she ran up and thanked me. She said, "Now I don't have to worry about not going to junior high!"

In a city known as the Big Carrot, streets that begin with a vowel and end with a consonant run east-west while those that begin with a consonant and end with a vowel run north-south. Other streets can go either way. A car driving north makes a left turn. Is it now traveling parallel or perpendicular to Eric Street?

ADVOCATES OF STRICT CURRICULUM ARE MIRED IN PAST

Irwin J. Hoffman

Irwin Hoffman, a teacher at George Washington High School, is a Presidential award winner for excellence in education and is a member of the advisory board for the National Science Foundation. He is a recent visitor to the Teachers' Center. This letter to the editor was published in the Rocky Mountain News, Denver, Colorado, on Monday, January 13, 1986. It is reprinted here with Hoffman's permission.

The editorial department of the Rocky Mountain News has strongly criticized the Denver Board of Education for postponing "tougher" graduation requirements. Thank goodness the board wasn't swayed by these arguments.

School boards around the country have instituted similar requirements for high school graduation. These more stringent standards are like the crusades of the 12th century, killing our educational system in the name of saving it. Saving our children by subjecting them to a curriculum that fits the industrial age (c. 1900-1940) is not the answer to the malaise infecting education. What was a "core" education 50 years ago is not a basic education today.

Society is just beginning to define what constitutes a fundamental education for our "Information Age." It is an education impacted by hand-held calculators, computers, word processors with spelling dictionaries and thesauruses, complex consumerism, the prospect of seven vocational changes in a working lifetime, an overwhelming abundance of data, the necessity of technical reading and writing skills, and the myriad of other aspects of our highly technical and rapidly changing society. In Denver, the courses students were taking to satisfy the "upgraded" graduation requirements did not meet these needs.

Communities around the country are judging the quality of their schools on the results of the SAT and ACT examinations, tests as hopelessly anachronistic as the curriculum that engenders them. These tests examine, to a large extent, rote memory and algorithmic skills for a society that needs a citizenry with a different array of talents. The screening tests do not forecast real world achievement; they are designed as predictors of collegiate success.

The results of this malfeasance is twofold: 1) the growth of vast training programs within corporate America and 2) a resonance into the curriculum of a counterproductive emphasis on an "Industrial Age" education.

In Denver, the postponed graduation standards were regressive in nature. The students were allowed two non-core classes a semester. Non-core classes, labeled electives, included typing, word processing, drama, journalism, music, art, electronics, computer courses, industrial arts, oral communication, business classes, ROTC, foreign languages and many others. In the case of a student planning to attend college, one elective was pre-empted for the required foreign language requirement. A college-bound student who is a musician and wants to continue with the orchestra or band would have been unable to take any of the other courses described above. In a similar way, students interested in an intensive pursuit of computer science, business, art or debate had to limit their high school experiences to very narrow areas.

In the first year of the new requirements, a year affecting only those students graduating in 1989, the computer education department at George Washington High School dropped from a daily enrollment of over 700 students to less than 500 students. A projection of the impact of this kind of attrition on other non-core courses necessitated another look at the requirements.

A basic education in our society should allow and encourage students to experience a variety of curricular offerings. The demise of the elective program was too heavy a price to pay for the core graduation requirements. Our egalitarian society must satisfy many interests and the appropriate education for its citizens requires an intelligent infusion of core skills within the elective courses as well as the development of new courses that articulate with the needs of our society. Such changes in curriculum take a long time and, obviously, the Denver Board of Education recognized that fact.

Three years ago, the National Council of Teachers of Mathematics declared that the use of the hand-held calculator should be part of the mathematics curriculum and that the years spent in learning the long division algorithm could be better spent in applying mathematics to real-life situations. This was a new definition of an Information Age "basic" from the national organization of the mathematics discipline. Yet, conservatives who were educated in the Industrial Age are fighting this change. This intransigence is occurring even when these same people admit they no longer do long division by hand.

Change is slow and the new requirements being instituted across the country often do not properly take into account society's new needs. It is encouraging that Denver is taking a more thoughtful approach. Perhaps other school boards will re-examine what the new standards are doing to their students and will develop courseware that:
1) recognizes students require an ownership in the learning enterprise; 2) reflects an awareness that contemporary society has emerging needs and education must be responsive to these Information Age enterprises, and 3) demands appropriate evaluative instruments with which to judge student achievement.

FEELING SUCCESS

Terry Lignoul

Children are being raised in a world that is, in most cases, based on competition. Throughout life, performance is often rated on some type of scale. Job performance is rated and rewarded by the amount of raises or promotions an employee receives. Men tend to rate women on a scale from one to ten by appearance. In sports, only the top performers make the team. Whether this competitive outlook is right or wrong is not the question. What happens to the ones who do not get the raises or promotions, do not make the team, or do not have a perfect appearance is the question. Every time a person is rated "low" on any type of scale, self confidence is diminished.

Teachers, without realizing it, rate children from the first day in kindergarten. Every time a grade is put on a paper, a child is rated. Why is this such a necessary part of education? An above average or an average student is not hurt by the grade put on his or her paper, but the below average or poor student is. Imagine receiving a "D" or "F" the majority of the time. This would be devastating to one's self confidence. Without self confidence, being or feeling successful is an uphill (if not lost) battle.

Teachers may argue that the curriculum demands a grade be given to each student. And since parents want to see how their child is progressing, sending daily or weekly papers home with their child (with a grade on them) is the easiest way. But the easiest way is not always the best way. The curriculum may require a grade be given but there are alternatives to putting a grade on papers handed back to students. If the teacher must write down a grade, write it in the grade book. When writing on the students' papers, try phrases like, "Good work", "Need to try harder", "Much improved", "Let's talk about this", "Can I help you with this?" etc. If parents need progress reports, try a conference or a weekly progress report (that is sent home) or a phone call. (How about an occasional positive phone message every so often?)

In education, the student is the most important concern. Each time a paper with an "F" is handed to a student, watch that student's reaction and the reaction of the other students who see the grade and poke fun at the child. Ask yourself, "Is that the best thing for that student?" "Did I build self confidence or destroy it?" The answer should be clear just from looking at the student's reaction. It's something to think and do something about.

In a different language luk eir lail means "heavy little package," bo lail means "heavy man" and luk jo means "pretty package." How would you say "little man" in this language?

TWO NUMBER TASKS AND A FIVE-YEAR-OLD
Patricia Freuler

The subject I've been working with is a five year old kindergarten girl. She had no previous exposure to pre-school, play groups, etc. before entering kindergarten.

1. The Counting Task

I began by asking her to count from 1 until I asked her to stop. She counted perfectly to 12. I then told her to begin at 42. She counted from 42 to 49 without any difficulty. At this point she hesitated, her lips barely moving as she counted by tens to see what came next. She said "50" and continued counting up to 59 where she stopped. She silently counted by tens once more to give the correct response.

I then asked her to count from 94. She proceeded from 94 to 100 without hesitation. I was not quite sure she would be able to continue, but she did. She reached 119 before she stopped again. At this point she could not go on. She returned to 101 and recounted to 119. Again she could not go on. Her responses were as follows:

"...108, 106, 109, 110, 111, 112, (hesitation)
113, 114, 116, 118, 119, (long pause)"

"113, 114, 115, 116, 117, 118, 119, (long pause)"

"116, 117, 118, 119, (long pause)"

"50"

After this last response, I stopped her. She began grasping at any number that might take her to 120. She could not make the connection between 19 and 20 and 119 and 120.

2. Hidden Chip Task

This task began when I asked her to count thirty (30) Lego building blocks. She lined up the pieces neatly into two vertical rows before counting them. However, she did not count accurately. She counted ahead as she touched the pieces. I then asked her to count the blocks as she moved them one by one. Again, she counted ahead as she touched the pieces, moving them from one side of the table to the other. Counting randomly-placed Legos yielded the same result. She used her knowledge of counting by rote to keep saying counting words, even though she could not accurately assign a number to each piece.

As we played "Hidden Chips" with ten Legos, she had to put the showing Legos into rows before counting them. She refused to count Legos placed randomly. Each time I hid Legos, she lined them up in two rows.

1	6
2	7
3	8
4	9
5	10

I began to hide one piece at a time, it was interesting to watch her thinking processes. I placed one piece under my hand. She again lined up the pieces in this order.

1	6
2	7
3	8
4	9
5	

"You have 10 underneath your hand," was her response. (This was not ten pieces that she was referring to, but the number 10.)

When I took away two pieces, she again placed the Legos in the same vertical order. She then exclaimed, "9 and 10 are missing."

1	6
2	7
3	8
4	
5	

It was interesting to note that the above procedure worked only with one and two hidden pieces. With any higher number hidden, she could not calculate the missing pieces--even by saying 8, 9, and 10.

In Boontown streets that begin with a vowel run east-west unless they also end in a vowel in which case they run north-south. Other streets can go either way. Berkeley street is perpendicular to Alice Street. In which direction does Berkeley run?

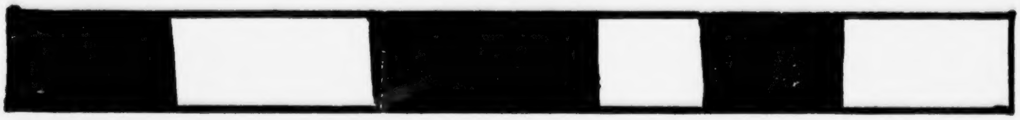
THERE IS MORE THAN ONE WAY TO SOLVE A PROBLEM

Brenda Dunning

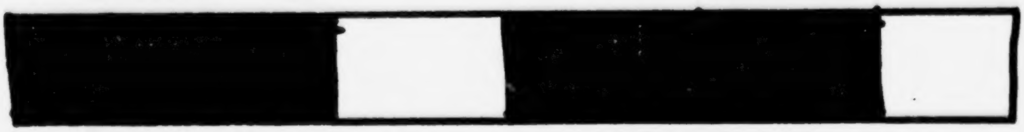
I have been in many classrooms for different reasons at different times in my life. One observation I have made over the years is a teacher "giving" a student the "one correct way" to do a problem is pretty common. Teachers give of their knowledge freely in the classroom. This is a valuable thing for a teacher to do, but, more so, it is important to watch as students show you, the teacher, the way to get to a solution.

Recently, while doing a child-watching activity, I observed first-hand one problem solved several different ways. I thought it wonderful that the students involved could solve the problem, without any prompting from me, and each in a different way.

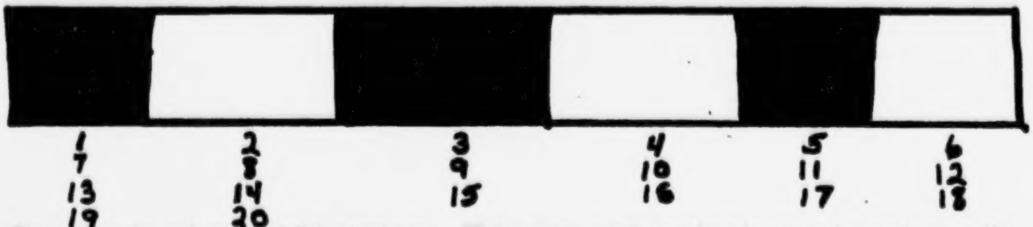
The problem involved checkerboard patterns. I asked the students to tell me what the twentieth block would be if the pattern continued. One pattern looked like this:



The second pattern looked like this:



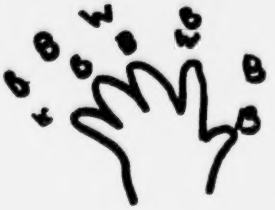
The first student, Sarah, is 8 1/2 years old and in the third grade. Since I had not tried this activity before, I first tried to figure the problem for myself. I figured that the odd numbered blocks were black and the even white, thus the twentieth, being even, would be white. I don't know if I expected Sarah to use the same solution, but I had not thought of using the solution she did even though the method is quite simple. This is the pattern Sarah used to solve the first:

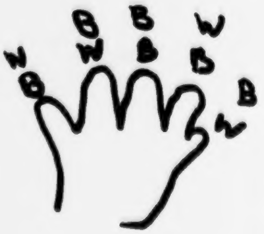


Counting is a basic child strategy. This was such a simple way to arrive at the solution I was amazed I hadn't thought of it. But then, I am not a child. How sad that some teachers will not allow children to use their fingers to count when this is such a natural skill for them. As you can see, Sarah used a familiar counting strategy to solve an unfamiliar problem.

The second student was Daniel. Daniel is 11 1/2 and is in the sixth grade. I gave Daniel the same pattern I had given Sarah. Daniel looked at the row of blocks and quickly told me twenty would be white. I was astonished not to have seen any counting. When I questioned Daniel as to how he arrived at the solution, he told me the even were white and therefore the twentieth would be white. So Daniel had used my more adult way to solve the problem.

But unlike Sarah, Daniel used a different strategy to get the answer to the second problem. The second pattern was more difficult to solve since the even--odd strategy does not work as well. I myself held a picture of the pattern in my mind until I could see the twentieth block. This was a cumbersome strategy and one I had to rethink before I was sure I had come up with the right answer. I was tempted to draw the pattern completely until I could visually see the twentieth block. Therefore, I did not expect that Daniel would easily solve the second as he had the first unless he used the same strategy Sarah had used. To my surprise, Daniel had another way to arrive at the answer. He used a counting method, different from the one Sarah had used. He used his fingers and counted out the pattern:





and again until he had gone over his fingers twice.

There are only two students, two problems, and just one prospective teacher who once again learned that children think like children, solve problems like children and happily can teach a teacher. I hope teachers will begin to let their students solve problems using their childlike ways and I hope that each teacher will be as amazed and happy as I was. After all, there is more than one way to solve a problem.

Paul and Tom are the same age. Paul is older than Cynthia. Cynthia is younger than Hal. Is Paul older or younger than Hal – or can this not be determined from the information?

PRE-CONSERVER TO CONSERVER IN ONE EASY LESSON?

Bob Cowles

After several weeks of reading about Piaget's stages of development I decided to test the theory of conservation of liquid with my seven-year-old daughter, Erin. I took two glasses, one tall and thin, the other short and wide, and set them on the kitchen table. The shorter glass had the greater volume. I called Erin into the kitchen and told her I was fixing sodas and asked her which glass she wanted her soda in. She quickly chose the taller glass. I asked her why and she responded that it was bigger. I then asked her if that meant it would hold more soda. She studied both glasses and decided that "yes" the tall one would hold more because it was bigger.

At about that time her ten-year-old brother, Clayton, came into the kitchen, so I explained to him that I was fixing sodas and asked which glass he wanted his soda in. After studying both containers rather carefully and being unable to decide with certainty which one to choose, he asked if he could take the glasses to the kitchen sink. I said sure, and he proceeded to fill the glass with water and pour it into the shorter glass, thereby applying the principle of conservation of liquid and discovering that indeed the shorter glass held more. He then announced to his sister and me that he would take his soda in the shorter glass and smiled proudly.

I again asked Erin, the seven-year-old who had been closely watching her brother, which glass she wanted. Following her brother's example she pointed to the short glass. I countered that the other glass was taller. She agreed, studied the two glasses again and asked if she could take them to the sink. Sure, I said, assuming she had learned an important lesson from observing her brother. She proudly marched to the sink and filled the taller glass and set it on the counter. Then she took the shorter glass and filled it with water and set it next to the taller one. She carefully peered into each glass perplexed that she still couldn't discern a difference to prove that one glass was better than the other. Finally in frustration she looked at me and said, "I don't know. You decide."

The moral to the story: Knowledge really isn't a spectator sport.

CUTTINGS

Teachers who come to the Teachers' Center turn in a weekly diary. In it they've written about what they've been reading, activities they've tried with kids and their observations of children's thinking along with general comments they wish to make about what they've been thinking, reading, doing and observing.

Many of these diaries contain material that is too good to remain buried in someone's file; it begs to be shared. So, in "Cuttings" we've simply lifted parts of individual diaries and reprinted them. Read them, think about them, share them and help them grow.

CUTTINGS

Aggie Raine

In a child watching task, I asked children to make as many pairs as they could out of three coats and four hats. Most of the children in kindergarten were able to make 10 to 12 pairs when given the manipulative task (cut outs of hats and coats), but when given a paper and pencil task (hats and coats drawn on a sheet of paper), they were able to make only three to four pairs. By the age of 9 or I0 I could see that most of the children were able able to do both tasks successfully. What I see going on here is that the children in the lower grades felt free to make many pairs when they could manipulate the objects, but on paper that freedom was gone. Once everything was paired they didn't think they could go any further. According to Hassler Whitney, "Children do what they are supposed to do and don't do anything else." Around the age of 8 or 9 some children were confused; they weren't sure, but were beginning to get the idea of making pairs on paper. By the age of I0 most of the students clearly understood that both tasks were essentially the same and the results showed that. The children I gave the task to were of low, average, and high intelligence according to their teachers. The most interesting point was that as children were making pairs using the manipulative objects, they were able to hold the pairs they had already made in their head. Very few children asked me if that was a pair they had already made.

Another observation was the look children had on their face when doing the two different tasks. Most children had a confident look when doing the manipulative task, but they had a very confused look when doing the paper and pencil task.

In a foreign language ho lew gi means "buy every dog," lew ra means "dog food," and gi trj nk means "every green car." Which words would you use to say "every food"? (Ignore the order of the words in answering the question.)

CUTTINGS

Christina Stamps

Young Children Reinvent Arithmetic by Constance Kamii

This is a wonderful book. The first part makes you think and tells you why the program will work and why its necessary. The second part of the book shows you what to use and how to use it and the last part answers all the questions you may have had about this program.

It was nice to read that I had many of the same questions and doubts that Kamii had. She called herself a skeptic and I guess I am, but being a teacher is a big responsibility. You are responsible for the children in your class. Being a skeptic is not necessarily bad as long as you have an open mind too. It just means that you take your job seriously and you want the best for the students in class. Change is not easy but she knew enough about children and cared enough about them to take a risk.

I'm going to recommend this book to every first grade teacher I know.

CUTTINGS

Beth Weisenstein

"The Child as a Scientist"

To see or observe the child as a scientist, adults also need to be scientists. "(T)he best way of getting some insight in young children's thinking is not so much to talk about them as to have them around and to look at them--to listen to them as well." I feel quite fortunate at S.I.U. to have the chance to do field experience of observing and listening to the children. At the same time, however, I get to observe the teachers and see how they have stopped looking at and listening to their students. They (I should not say "they" meaning all teachers, but the teachers I have observed) seem so concerned about trudging through the text material that the teacher often forgets to take notice of the students. It is of utmost importance to keep in touch with and continue to read and listen to the students because they are constantly changing entities. Their moods change as often as the teacher's. She/he needs to keep tabs of where the students are because different teaching techniques should accompany different kids and their moods. How often do teachers really observe and listen to the students? For many, I feel it is not too often.

As mentioned in the article, children discontinue being scientists when teachers spoon-feed information and children are only required to fill in blanks. There is no wonder to the answer as to why children can no longer be creative or think abstractly when they come to formal operations. They have been subdued for so long that it is hard to arouse them again.

The article mentions that "mistakes are a natural part of growing and learning." When every mistake is graded and calculated, how can children learn naturally from their mistakes? School should be a place where children can experiment and learn how to solve their mistakes in a manner meaningful to the child. Different types of mistakes are: 1. mistakes that are signs of progress or theory building, 2. mistakes that result from just not having paid attention to a bit of information given, and 3. mistakes that are really due to some kind of concept not yet having developed. How often are mistakes analyzed? When a teacher does find the source of the mistake, how often does she/he try to solve or guide the mistake toward understanding?

CUTTINGS

Aggie Raine

"Basic Skills Issues and Choices" by Thomas C. O'Brien

"Basic Skills Issues and Choices" was a loaded article. By this I mean there was so much information which will be valuable to me. It gave me a different perspective for looking at children's thinking skills. The constructivist view sees children as active learners, not passive. What I mostly see in the classroom is passive learning. The children are being spoon-fed and not allowed the space to discover and explore on their own. School should just provide for the students the raw material - experience - from which the constructions are built. Thinking should be encouraged. There are four factors that contribute to knowledge development: maturation, experience and activity, social transmission, and self-regulation.

It was interesting to learn that there are two types of memory - narrow (strict) and wide. Most students are only asked to use their narrow memory. If children could use their wide memory more often, this would be great! They would actually be interacting with their environment. You would never want to use just the narrow sense; likewise, you would never want to use just the wide sense. They are supportive of each other. There are dangers at both extremes. The narrow sense makes learning too having to learn the "right words" while the wide sense makes learning too vague and without substance. They need to be used in concert. This is a difficult task for the teacher but extremely powerful if successful.

COMMENTS

Teachers need to know how students think. How can we find this out if we don't make an effort to talk with them and answer their questions? We assume that children are helpless. The fact is that they know and experience more than we as adults can ever imagine.

CUTTINGS
Cheryl Smith

CHILD WATCHING

I asked children ranging in age from 4 to 9 1/2 the questions, "Where does the sun go at night?" and "Why does it get dark at night?"
Following are the responses I got in order from the youngest to the oldest.

Sarah - Age 4
"The sun goes home."
"I don't know."

Gayle - Age 4 1/2
"I think on the other side."

Vicki - Age 4 l/1
"Behind the clouds."
"I don't know."

Lyndsay - Almost 5
"Behind the clouds."
"So you could sleep."

Kelly - Age 5
"They go night-night in the sky."

Fran - Age 6
"Down."
"Because its night time."

Kyla - Age 6 l/2
"Behind the moon."
"Because the sun goes down."

Vicki - Age 6 l/2
"It turns away from the earth."
"Because the earth turns away from the sun.

Amy - Age 7
"Down."

Brian - Age 7
"It turns into the moon."
"Because the sun is on the other side of the world."

Tony - Age 8
"It turns around."
"Because the sun goes down."

Joey - Age 8
"It spins around."

"The sun goes down and the moon comes up."

Shannon - Age 8 1/2
"Well you see, it turns around and it switches to the moon. The other part of the world gets the sun and we get the moon."
"Because I can sleep better when its dark."

Fred - Age 9
"It goes to China. Also the Soviet Union."
"Because the world turns around."

Beth - Age 9 1/2
"The world turns and the sun gets to South America and then the moon comes up. And then in the morning the world turns back around."
"The earth turns around and the other half of the world (South America) gets the sun and North America gets the moon."

It seems that the children ages 4, 5, and 6 have a philosophy of "Out of sight, out of mind." They seem satisfied with a simple explanation to explain why they can no longer see the sun.

The children at age 7 seemed to be developing the idea that something was turning or spinning, but they weren't sure exactly what and how it happened.

From age 8 on up the children seemed to have the idea that the sun is still shining somewhere else in the world. I expect by age 8 they have had some formal school instruction about the rotation of the earth.

Some of the children seemed to have the two concepts lined together, while others did not associate them at all.

Circle the letter in the name Anthony which is 3 letters before the letter that follows the middle letter of the name.

CUTTINGS
Joyce Bishop

THE ENQUIRING CLASSROOM:
An Approach to Understanding Children's Learning
Stephen Rowland
The Falmer Press
London and New York
Taylor and Francis, Inc.
Philadelphia, PA 19106-106

"A Framework for Classroom Enquiry" Chapter l

The first phrase that really captured my attention was one that distinguished between two modes of teaching: transmission mode and interpretive mode. In thinking over my classroom experiences, I realize that a vast majority of my education was done in the transmission mode. A good recent example of interpretive mode was the preschool program in which my daughter was enrolled. The setting was colorful and filled with interesting, changing objects to manipulate and investigate. The children had chances to experiment with a wide variety of art and science materials. There was a tolerance of noise and mess which was not inhibiting. The teacher showed an interest in and acceptance of each child. It was an exciting stimulating situation for a child. I am convinced of the value of the interpretive mode.

The comments on the autonomy of the learner again make me despair of much in the present educational system. Do large classes necessitate unresponsive teaching behavior, or are there methods which permit some degree of autonomy and self-determination, even in classes of 25-30? The computer can help here, but it will take more than one per classroom.

Michael Armstrong's concept of appropriation makes sense to me. I can see that appropriation is a life-long process for those who struggle toward wholeness. What a luxury it would be to spend a year analyzing and writing as he did. Do you suppose he was under some kind of grant or financial support? I think it would be a real treat to have a similar opportunity to observe and work with children in a classroom without having the primary responsibility for their progress.

"Relating to Children" Chapter 2

In this chapter, Rowland describes several investigations children make, in which they follow their own lines of thought with a minimum of teacher guidance. Specifically, it seemed remarkable to me that Paula and Carol were able to use such a variety of odds and ends and still keep to a definite scale. In the case of David and Greg exploring Fibinacci patterns, I am amazed at the great lengths and the sophistication of their work.

Rowland makes several points in favor of allowing children some control of their own learning, and the room to work out problems in their own way. The example of Dean and the caterpillar shows how a boy taking his own circuitous route eventually classified on a more sophisticated level with more understanding than he would have if he had merely copied the teacher's suggestions. His example suggests that the degree of control a child has over his learning is related to the amount he absorbs.

Concluding the chapter, Rowland makes a telling remark. "But there is a strong sense in which as soon as they begin to tackle real problems, problems as they have constructed them or interpreted them, then learning takes place and the knowledge which is gained is not merely a copy of our knowledge, but is a reconstruction of it." (page 37) This might be the difference between the kind of teaching which is forgotten over the weekend, and the kind of learning which is absorbed and lasts.

"The Material Environment" Chapter 3

In Chapter 3, Rowland uses a different setting, the old barge canal, to examine how the children explore and develop hypotheses to explain what they find. They are not interested in outside sources of information while they make up explanations and search for proof. Again, their own control of the investigation contributes to their enthusiasm and energy. This account suggests that we should not be too quick to provide the strategy that always solves a problem, or the reference containing the final word about a question under discussion.

"Abstract Thinking and Hypothesizing" Chapter 4

Again, the question of the child's control comes up. Rowland thinks that greater choice and control by the student results in his functioning at a much higher level. He gives plenty of evidence that these 9- and l0-year-olds are doing formal operational thinking which Piaget did not consider likely until roughly age l2.

"Representation" Chapter 5

I've not seen this kind of analysis of children's writing before. It's interesting, and I appreciate the respect Rowland shows for the children and their work.

Again, freedom to choose their own combination of talking, writing, drawing and making displays seems essential to permit the children a keener appreciation of the explorations they were doing. These choices do not occur often in typical classrooms as I know them, except perhaps the choice of a term paper topic, or what to do with a few minutes of "free time".

Reading Rowland, it appears that writing is a necessary part of a child's effort to come to terms with the world and his place in it. According to Rowland, writing allows children to put some distance between themselves and their experience, to objectify it, look at it critically, or perhaps to 'operate' on it. Because they can 'operate' on their experience, they again have some control. Rowland suggests that they are able to gain some control over their imagination in this way, and therefore over their intellect.

Chapters 6-8

Rowland is a keen observer, he sees so much when he observes a youngster, or studies his writing. It isn't just verbal padding either - it makes sense.

Accustomed to traditional classrooms as I am, it is hard for me to picture how children can be sure to master basic skills when so much time is spent in pursuits of their own choosing. I remind myself that he did mention some periods which were more structured, but his investigation was more interested in the unstructured times. Also, even when children spend much time practicing basic skills, they do not always master them.

Some points I liked:

I) A close examination of children's learning will lead to a better understanding of our own learning, and vice versa.

2) He restates the need for children to have control over their learning. Children decide the purpose of their activities and judge the value. Their play involves exploration and adaptation that leads to learning.

3) The teacher is not a helpless bystander, however, but should develop a 'conversational relationship' with the student. The teacher can encourage them to think over what they are doing, suggest new ideas or alternative perspectives, or set up a dialogue. But expect the unexpected as the learner reinterprets our offerings.

4) By transforming our ideas into their own unique form, children construct their own truth and confirm their control over their activity.

This probably explains why many well-meant activities have fallen flat on somebody's face. It may have been an interesting idea, but the learners were allowed no control, and did not have a chance to construct their own view of the problem.

A point not stressed elsewhere in the book is that there is a close relationship between skill and creativity. Inventiveness may lead to the need for a new skill, while new skills enlarge the potential for creativity.

Rowland's idea for a group of teachers within a school to form a unit of inquiry; observing, sharing, interpreting observations of learners sounds like another version of the Teacher Center, and yes, it has lots of potential benefits.

CUTTINGS

L. Hoeke

I had the opportunity to work with a sixth grade class for several days. As I worked with them I noticed that, as a group, they tended to lack direction and the capability to develop alternatives to problems. The most obvious display was their argumentative attitude. They did not and could not think of alternatives to fighting with one another and I ended up playing judge and jury rather than helping them develop alternatives. This lack of alternatives also affected their ability to work out homework problems.

They did their homework problems simply to reach an answer, rather than figuring out how something works. An illustration of this is one child's inability to deal with a simple Krypto problem. (Krypto is a game using the math functions on five numbers to reach a standard solution. We used numbers between I and I0) Bobby's mathematical capabilities according to testing were slightly below average for the "normal" sixth grade child, but he could easily work with the numbers used in the game. As he worked the problem he was frustrated with his inability to get the right answer the first time, and extremely frustrated with having to search for new solutions to the problem. He finally became so frustrated that he simply refused to try anymore. Even with encouragement and minimal help he would not try very hard. He appeared to only like knowing exactly how a problem was to be solved and then plugging in the numbers to reach the answer.

I have not given up on this class but am instead offering opportunities for exploration. In science we were working with electricity and batteries. I brought in batteries, lightbulbs, and wire. Basically I set the materials down in front of the class and told them to see what they could do with them. Then, I wandered around and asked pertinent questions and helped direct the path of each group. Most of the children embraced the idea of "playing" or working with the batteries. What was particularly gratifying is the rest of the time I worked with this class, many of the children would come up to me and tell me what they had discovered at home or show me a motor, buzzer, or switch they had taken out of a toy. They were truly excited about what they were doing and learning.

CUTTINGS

Aggie Raine

Your positive comments on my journal led me to analyze my method and approach to. Different students asked me last week I write about? I said "kids" mostly. I've learned from talking to different people that others' approach to "child watching" tasks may be somewhat different from mine.

When I approach a child I intend to watch, I don't just do what is expected, but I search a little deeper, and it's when I do this that I discover something new. In class you said, "So what?" about the "tilty cup" experiment. Well that's exactly what I thought when I began the task. As I look at how different children are responding to a problem I look for patterns or clues to perhaps lead me to some answers. I'm really curious about kids and how they think.

I've had this curiosity not just about kids but about lots of things. Many times it has gotten me in trouble, especially as a child. I was the child who always seemed to find a different way to do things and I got slapped down for it. I believe some people have difficulty allowing themselves to follow their feelings. I am glad that as an adult I still have the curiosity to search for answers.

I believe curiosity is the key to "child watching" and that's why it is fun and enjoyable for me. Kids have always amazed me. I can watch real little ones for hours and never be bored. You can learn so much from toddlers as they explore their world and try to make sense out of it. When I had my own children, I spent many hours watching them and wondering why they did what they did. The point I am trying to make is, some of the students in your class who haven't been around children a lot, have difficulty engrossing themselves into the mind of the child. I don't believe "child watching" can be effective unless you allow yourself to see children from their world - a difficult task for some. When I talk to some of the students in our class about "seeing into a child's mind," I don't believe they understand exactly what I mean. It is very difficult to explain it - one has to experience it. I thought everyone was seeing the same things I saw in kids, but I don't think it's the case. There is a line you have to cross in order to see into the mind of a child and you need to be open and flexible. I find this lacking in many adults. We live in such a self-centered world. Children do not ask for much - only be to understood!

In order to understand children I think you need to understand yourself. I listen to the right side of my brain and have a tendency to by-pass logic and follow my intuition. It may have gotten me into trouble as a child in elementary school because I was not one who liked to follow the directions and do worksheets - most of my time was spent daydreaming. I've always loved to write and draw. I guess as a child I picked this up because it became an outlet for me to express myself.

CUTTINGS

CHILD WATCHING CAN BE DANGEROUS

Cheryl Smith

Fran, age 5, had been playing the hidden coin game with me earlier in the day as a part of my child watching assignment. She came back to my house and asked to play the game some more and I jumped at the chance to get some extra data. The following episode transpired:

(2 coins showing and 3 coins under my hand)

Interviewer: Fran, how many coins are under my hand now?

Fran: Aaaaaaaaah! (Turning red in the face.)

Interviewer: Oh my God! She's choking! Frank help me!

At this point I jumped out of the chair. Turned Fran upside down and shook her vigorously while my husband hit her on the back.

Fran: It's out now.

Interviewer: Thank God? Are you okay? (Long embrace and many tears followed.)

Fran had a piece of hard candy that my daughter had given her lodged in her throat. From this experience I learned a valuable piece of child watching information:

WHEN A CHILD GASPS FOR AIR AND TURNS RED IN THE FACE IT IS TIME TO STOP COUNTING COINS!!!!!!!

CUTTINGS

Renee Barker

I was talking to the mother of one of the children I observed this week and she told me a real horror story!

A few weeks ago, Kelly, a second grader, came home with the assignment of learning several multiplication tables (2's, 3's and 4's). She was going to be tested on them in two days.

This was the first exposure this child ever had to multiplication and she had no idea of what it meant. Her mother tried to help her memorize the tables. What resulted was a frustrated mother and a child who not only felt frustrated but inadequate. And if this is not all bad enough, after the child took the test no attempt was made at school to help the children understand multiplication. In fact multiplication wasn't mentioned again.

The mother checked with the teacher to find out how Kelly had done on the test. The teacher didn't know yet because the tests were being scored. A standardized achievement test had been given and that was why the students were asked to learn the multiplication tables - to make the students score higher and make the district look good.

This little girl feels so confused and frustrated now. I hope that when the time comes for her to learn what multiplication is, she won't be totally turned off because of the ignorance of one teacher (or school principal). When she faces multiplication again, she'll feel she's a failure before she even begins. All because of the ignorance of people who are in the business of ridding the world of ignorance. Ironic isn't it!

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